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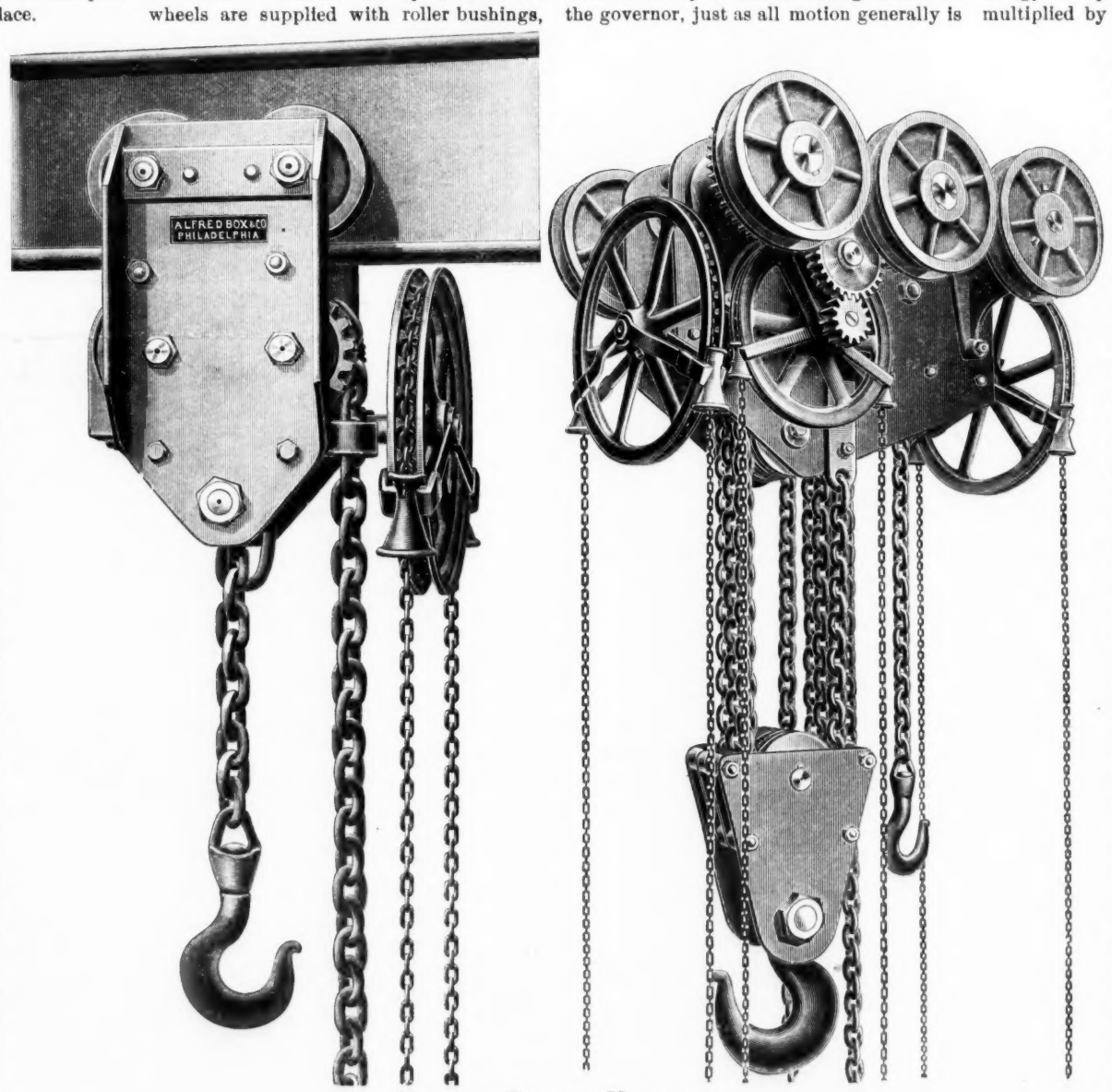
Improved Hoisting Machinery.

We give on this page illustrations of some improved hand hoisting machines, as now built by Alfred Box & Co., Philadelphia.

The first machine shown is a combined hoist and trolley, which is built in four different sizes, with capacities ranging from 2 to 15 tons.

As will be perceived, this hoist is adapted to run upon the lower flange of an I beam, and, where this beam is already in place and its ends not accessible, one of the side plates of the hoist is easily removed for the purpose of putting the hoist in place.



IMPROVED HOISTING MACHINERY.

These side plates are made of pieces of steel channel beams, as shown, giving very great strength and rigidity in proportion to weight.

The trolley wheels are fitted with roller bearings and have rounded faces (highest in the middle of their width) so that they run very freely and smoothly upon any beam, regardless of variations in angle of flange.

The hoisting machinery consists simply of two worm gears, which are placed upon parallel shafts; one of these gears being right hand, and the other left. Below these runs a worm shaft which has two worms upon it—right and left hand, and these drive the worm gears in opposite directions. The hoisting chain passes over a wheel upon one of these shafts, and the shafts are connected also by spur gears; the result of this arrangement being that the work of hoisting is divided equally between the two pairs of worm gearing, and the end thrust of one worm is perfectly balanced by that of the other. By this construction also there is twice as much bearing surface between worms and wheels as would be the case otherwise.

For the heavier loads to be lifted with this hoist a greater ratio of speed between hand chain and load is obtained by simply passing the suspended hook through the link seen attached to the hoist, and, in the loop thus formed, using a movable sheave with hook, thus reducing the speed of hoisting one-half, and correspondingly increasing the capacity. This movable block constitutes a part of all except the smallest size.

The trolley wheels are geared to be moved by hand chain when desired.

The second engraving is a heavier machine made to run on top of two beams, so that all possible head room is obtained. This hoist is built in six sizes, ranging in capacity from 5 to 40 tons. Each of these machines is, in reality, two complete hoisting machines, geared and worked in the same manner as the one described above, the ratio of their speeds being 1 to 6, and the larger size intended for loads up to 8 tons at the rapid speed and up to 40 at the slower. It will be noticed that there are three pairs of trolley wheels, those at the right being lighter than the others and intended only to assist in supporting the lighter loads, which are suspended from that end.

Spur gears at the side, driven by a third hand chain, move the trolley along the beams, the pair of wheels at the left being the drivers. All the trolley and sheave wheels are supplied with roller bushings, and the hook is supported upon balls so that it turns easily.

Theory of Steam Engine Governors—IV.

BY J. BEGTRUP.

The preceding articles on this subject will be found in the issues of October 19th, December 14th, and January 18th. Referring to Fig. 11 in the issue of December 14th it was stated that the ball would at a admit just enough steam to run the engine alone, and at b it would admit full steam. It will hardly be necessary to call attention to the fact that a and b should have been interchanged. In my last article is a typographical error in the sentence: "Generally, a variation of 9 per cent. in rotative speed gives a variation of 29 per cent. in centrifugal force"; it should be q and $2\,q$ per cent. instead of 9 and 29, and the same mistake is repeated a little further on.

The action of a centrifugal governor depends on centrifugal force; an increase of centrifugal force moves the mechanism in one direction and a diminution of centrifugal force will cause it to move in the opposite direction. In the investigation of the action of governors the motion is considered relatively to the revolving motion of the governor, just as all motion generally is considered relatively to the revolving motion of the earth, and on this basis it is true that centrifugal force can produce motion, and that it may be considered as any other active positive force.

The object of this remark is to avoid misunderstanding, as it has so often been said that centrifugal force can produce no motion, that it is not properly speaking a force, etc.

The instantaneous variation in speed by a considerable and sudden diminution or increase of load depends mainly on the motion of the ball, the quicker we make the motion the more we reduce the instantaneous variation, and at the same time we reduce force y, and a closer approximation to isochronism may therefore be obtained. Now, the time of motion is directly proportional to the acceleration, and the acceleration is directly as the force and inversely as the mass; that is, the greater the force and the smaller the mass the quicker the motion.

This is one of the fundamental principles of motion which is of great consequence in governors, and it should be clearly understood how the action of a governor is delayed by the resistance of inertia of the several parts. It will also be well to remember that energy of motion or kinetic energy is equal to the unbalanced force multiplied by the displacement, and therefore if we reduce the mass we obtain a quicker motion without increasing the kinetic energy, or both time of motion and kinetic energy may be reduced by reducing the resistance of inertia. The same principle may be stated thus: By reducing the mass we increase the velocity without increasing the momentum.

In a governor the centrifugal force is supposed to act at the center of gravity of the ball in a radial direction, and if the motion of the ball be known the law of motion of the whole system is known. The center of the ball is called the "representative point," and it may be convenient to resolve the motion of this point in other directions, and we have then a resolved or projected motion of the representative point. In a gravity governor, for instance, it is convenient to consider the vertical motion of one of the balls. This simplifies the problems because the direction of gravity is vertical. Any force and resistance acting on the system must be reduced to the representative point and resolved in two directions, one coincident with the projected direction of motion and the other at right angles to it. The right angle component has no dynamic effect, and will therefore not enter the equation of motion. By thus representing all forces and resistances of the system as acting at one point in one direction the problems of governors are simplified, and we may then by algebra or otherwise obtain a clear conception or a positive knowledge of the motion. A practical illustration of this is in place here.

Fig. 23 (page 2) represents a governor of the Porter type. E and K are weights connected with the governor in such a manner that any movement of the balls will cause a corresponding movement of these weights. Each of the balls c weighs 10 pounds, and the central weight Q weighs 200 pounds. The extreme vertical motion of c is $1\frac{1}{2}''$, and is denoted by the letter l in the figure. The extreme motion of Q is $3''$, and we may, without appreciable error, assume any mo-

tion of Q to be twice the corresponding vertical motion of c. The vertical component of centrifugal force is indicated by an arrow, and denoted by f_1 in the figure, and the vertical effect of gravity reduced to the representative point is indicated by an arrow pointing in the opposite direction, and denoted by f. It is sufficient to consider one side of the governor, and using letters of reference to designate the weights of the several parts, it is evident that $f = c + 2\frac{Q}{2} = c + Q$, if E and K balance each other, and if we neglect the weight of the arms. The regulating power of a governor may be represented by the product $f \times l$, which in this case equals 315, but this must not be confounded with an expression for efficiency, for it will appear later that the efficiency of equally powerful governors may vary greatly. The force f remains constant in a gravity governor, but force f_1 may vary, and then there will be an unbalanced force equal to the difference between the two forces, which will act on the ball and cause it to move up or down, as the case may be. Under normal conditions $f = f_1$, but when equilibrium is disturbed there appears an unbalanced force, which is the resultant of the forces y_0 and y_1 and friction, as was explained in my article of December 14th. This unbalanced force, which I will denote by the letter y, was represented by a curve in Fig. 15. The mean magnitude of this force is proportional to the extent of the oscillatory motion, and it will, in the present case, be about 5 pounds for a vertical movement of $1\frac{1}{2}''$, and for smaller movements correspondingly less. Under the action of this force the ball will move up or down, and by comparing the magnitude of such force with the mass to be moved by it, it becomes evident that the resistance of inertia is of great consequence.

Let us find the effect of inertia of the central weight Q. It moves $3''$, while the ball moves $1\frac{1}{2}''$ vertically, and the effect on each ball will be due to $\frac{1}{2}\ Q$. As the motion of Q is twice the vertical motion of c, the resistance of inertia of $\frac{1}{2}\ Q$ will be as that of a weight equal to $2 \times \frac{1}{2}\ Q$, having a vertical motion equal to that of c, and as the leverage or static effect of inertia is also proportional to the relative motion, it follows that the resistance due to the inertia of $\frac{1}{2}\ Q$ will be as the resistance of inertia of a weight $= 2 \times 2 \times \frac{1}{2}\ Q = 2\ Q$, connected with the ball in such a manner as to obtain a motion equal to the vertical motion of the ball. Or, generally, let vertical movement of $c = l$, and movement of $\frac{1}{2}\ Q = u$, then the resistance of inertia of $\frac{1}{2}\ Q$ reduced to the representative point is equal to the direct resistance of inertia of a weight $= \frac{\frac{1}{2}\ Q\ u^2}{l^2}$. Let actual movement of $c = l_1$, movement of $E = e$, and movement of $K = k$; then the resistance of inertia of one-half the system reduced to the ball c in a vertical direction is as the direct resistance of inertia of a weight

$$= \frac{c\ l_1^2 + \frac{1}{2}\ Q\ u^2 + \frac{1}{2}\ E\ e^2 + \frac{1}{2}\ K\ k^2}{l^2},$$

and if the acceleration by an unbalanced force of one pound acting on the ball in the direction of l be denoted by a we have $a = \frac{12\ g\ l^2}{c\ l_1^2 + \frac{1}{2}\ Q\ u^2 + \frac{1}{2}\ E\ e^2 + \frac{1}{2}\ K\ k^2 + \ldots}$ inches per second, where $g = 32.2$. An expression which is perfectly general and directly applicable to all forms of governors. For $l = \frac{3}{2}$, $l_1 = \frac{3}{2}\sqrt{2}$, $Q = 200$, $u = 3$, $E = 10$, $e = 6$, $K = 15$ and $k = 4$, we have $a = .7$. This, then, is the vertical acceleration of the representative point when acted upon by an unbalanced force of one pound, and the actual vertical acceleration is given by the product $a \times y$. If the quantities c and Q be sufficiently great the quantities $E\ e^2$ and $K\ k^2$ will have comparatively little influence on the magnitude of a, and as force f and consequently force y is directly proportional to Q and c, it follows that heavy governor weights should preferably be used in such cases where heavy parts are to be moved a considerable distance by the action of the governor, for instance, in connection with a link motion, while such weights would be of little consequence in connection with a throttling governor on a Corliss valve gear. As the time of motion is directly proportional to the acceleration it should always be the object of the designer to increase the quantity a as much as is practicable without reducing force f.

Let us see if the governor shown in Fig. 23 can be improved. Let the weight Q be supported by a cross bar suspended from the balls as indicated in Fig. 24, and let the weight of Q be 400 pounds, or twice as much as in Fig. 23, then, as the vertical motion of Q is reduced one-half we have $f = 210$, as before, but now $\frac{1}{2}\ Q\ u^2 = 450$, while in Fig. 23 it was 900, and we have therefore now $a = 1.1$. The arrangement in Fig. 24 would therefore be a decided improvement. Let a fly-wheel weighing 5,000 pounds be required for the governor in Fig. 23, then $\sqrt{\frac{.7}{1.1}} \times 5{,}000$ pounds $= 4{,}000$ pounds would be sufficient for the governor shown in Fig. 24. Let us divide the central weight in Fig. 24 in two halves and add one-half to each ball so as to make it simply a Watt's governor with very heavy balls, then $f = 210$ pounds as before, also $c\ l_1^2 = 945$ and $\frac{1}{2}\ Q\ u^2 = o$ leaves $a = .7$ as in Fig. 23. The power and quickness of these two governors would therefore be exactly equal.

There would, however, be some objection

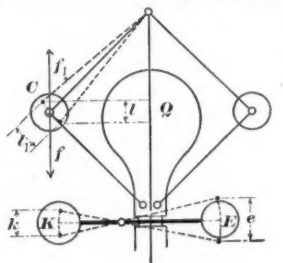


Fig. 23.

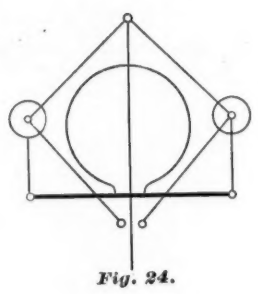


Fig. 24.

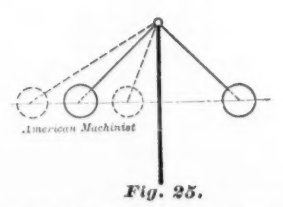


Fig. 25.

to having all the weight on the end of the arms, the twisting strain on the hinges would be greater, the speed would be very slow and the governor would not look so well. Suppose some load be thrown off suddenly so as to cause an instantaneous acceleration of the speed of the engine; then it is evident that the corresponding acceleration of the governor will be in direct proportion to the speed of the governor. Let the height of the cone be $12''$, then the speed would be 249 revolutions per minute for the governor with the central weight, and only 54 revolutions with the weights directly on the arms, and the twisting strain would be as 249×10 to 54×210, or nearly $4\frac{1}{2}$ times greater for the last-named governor, or generally the twisting strain will be $\sqrt{\frac{c + Q}{c}}$ times the corresponding strain on a governor with a central weight Q, provided this weight is free to turn on its support so as to cause no appreciable twisting action.

It would sometimes be useful to know what the greatest twisting strain would be. Let diameter of cylinder $= d$, stroke $= S$, greatest mean effective pressure $= p$, weight of fly-wheel rim $= W$, diameter of fly-wheel $= D$, speed of engine $= N$, speed of governor $= n$, radius of rotation of governor balls $= r$, weight of ball $= c$, then there would be a maximum strain on each ball $= \frac{d^2\ p\ S\ n\ r\ c}{D^2\ W\ N}$ if all the connections were perfectly rigid, but as there must be a certain amount of flexibility in all the parts and connections this formula would probably not give more than half the actual strain, and if there be any loose joints and consequently "lost motion" the strain may be much greater, and that is probably why guides were used on the first governors built. $d = 12''$, $p = 60$ pounds, $S = 20''$, $n = 216$, $r = 12''$, $c = 10$ pounds, $D = 80''$, $W = 5{,}000$ pounds, and $N = 200$ would give less than $2\frac{1}{2}$ pounds twisting strain on each ball if we make it twice the value obtained from the formula, while without the central weight and $c - 210$ pounds we have a twisting strain of 12 pounds.

Although it is sometimes difficult to obtain formulas which will give absolutely correct results, such formulas are, nevertheless, useful, for they give the relative values correctly.

Fig. 25 represents a Watt's governor without the sleeve and connecting links. Suppose that the balls must rise $1\frac{1}{2}''$, and that a variation in speed of 6 per cent. is allowed, then the height of cone will be $\frac{50}{6} \times \frac{3}{2} = 12\frac{1}{2}''$. But how far apart should we put the balls? It is evident that for a given vertical motion the actual motion of the balls will be greatest near the spindle, and smaller the further they are removed from the spindle, but it will also, by a closer investigation, appear that there is not much gained by making the angle between the arms more than 90 degrees, and this would make the governor of undesirable dimensions. The proper angle would, therefore, be 90 degrees. I think this angle is now very generally adopted—practice is ahead of theory.

Let us remove the central weight in Fig. 23, and put a helical spring on the spindle which shall exert a pressure on the collar equal to the weight we have removed, or 200 pounds, we have then a governor of the same power and same speed, but the inertia is very much reduced, for now

$$a = \frac{12\ g\ (\frac{3}{2})^2}{10.2\ (\frac{3}{2})^2 + \frac{1}{2}\ 10.6^2 + \frac{1}{2}\ .15.4^2} = 2.5,$$

while with the weight on the spindle we had $a = .7$. Suppose that a fly-wheel weighing 5,000 pounds would be required for the governor, with a central weight, in order to keep the force y_1 within its proper limits, as explained in my article of December 14th, then with the spring governor a wheel weighing $\sqrt{\frac{.7}{2.5}} \times 5{,}000 = 2{,}650$ pounds would be sufficient.

The instantaneous variation in speed by a sudden increase or reduction of load would not be greater with the light fly-wheel, for the action of the governor would be correspondingly quicker. The time of one free half oscillation of the gravity governor would be about one second, and of the spring governor about one-half second.

Here, then, we have an example of how the fly-wheel may be reduced to nearly half its weight by changing the design of the governor, and such figures as these will make it clear that size and weight of fly-wheel cannot be determined with any degree of accuracy, without knowing the design and dimensions of the governor. If we have a rule which in any case will make the fly-wheel heavy enough, then this would be a safe rule, but not an economical one. The first consideration is, of course, the strength of the wheel, and a built up wheel will probably be heavy enough, if a liberal margin of strength is allowed, and if the governor is well designed, otherwise it is hardly putting it too strong to say that the fly-wheel is part of the governor. But there are, no doubt, exceptional cases, where neither a consideration of strength of fly-wheel or design of governor would make the fly-wheel heavy enough. This might occur when the engine is used for incandescent lighting, but probably in no other case. It is not within the scope of this paper to explain the nature and extent of periodic fluctuations in speed caused by the rectilinear transmission of power from the cylinder to the crank, expansion and compression of steam and inertia of reciprocating parts. A great deal has been written about it, and it seems to be the only basis for the calculation of fly-wheels known to scientific men, and it is taught in colleges throughout the civilized world. The period of variation in speed from such causes is repeated twice during each revolution of the fly wheel, or once for each stroke of the piston, for instance, an engine making 200 revolutions per minute would have 400 periods of maximum and minimum speed in a minute. Such fluctuations may have some effect on incandescent lights, but a frequency of more than 400 per minute would probably prevent any perceptible flickering of the lights. This, at least, is the experience of the writer. On about a hundred engines built for electric lighting, and making from 200 to 350 revolutions per minute, the wheels were made as light as it was thought would be consistent with strength, having a rim varying from one inch to one and a half inch in thickness, and in no case has there been any flickering of the lights, and only in a few instances has it been possible by the use of a sensitive tachometer to discover any fluctuations in speed with a frequency equal to the number of strokes, notwithstanding that the engines were tested with only the governor pulley, and a comparatively small brake pulley on the shaft. After such observations, the question naturally presents itself: Is there any machinery or mechanical operation whatever, barring incandescent lighting, which is affected by such fluctuations in speed to a greater extent than is a sensitive tachometer? This, of course, represents an engineer's view of the matter, while the only object of the scientific investigator seems to be to show that such fluctuations do exist, and how they can be confined within certain limits, without considering whether it is at all necessary to try to confine them. To avoid misunderstanding, it should be stated that the engines above referred to were provided with a special form of governor, which operates equally well with light and heavy fly-wheels, and for this reason the weight of the wheels was not taken into consideration by the designer.

Fluctuations in speed due to the varying rotative effect on the crank would, of course, be greater in slow running engines unless the moment of inertia of the fly-wheel is increased, for the periods of acceleration and retardation would be longer, and any variation from mean speed would be greater comparatively, *i. e.*, it would be greater when expressed in per cent. of mean speed, and according to the theory based on such fluctuations, the moment of inertia of fly-wheel should be inversely proportional to the speed squared, while according to the formula which I shall give the moment of inertia of fly-wheel should be inversely proportional to the speed of the engine. But in this formula the dimensions of the governor also enter, and the result will, therefore, vary considerably according to the speed of the governor. If, for instance, we have an engine making 100 revolutions per minute, and we speed it up to 200 revolutions without changing the speed of the governor, then the moment of inertia of fly-wheel could be reduced one half only, but if the engine had an ordinary shaft governor the speed of the governor would also be increased to 200, and the efficiency of the governor would be increased in nearly the same proportion, and this would enable us to reduce the fly-wheel once more in nearly the same proportion; that is to say, when the speed of the governor bears a fixed ratio to the speed of the engine, then the moment of inertia of the fly-wheel should, theoretically, be nearly inversely proportional to the square of the speed, just as it should be according to the other formulas I have referred to. But this is only a remarkable case of coincidence, for in other cases, for instance, by throttling engines and Corliss engines, these formulas would give very different results. As to the relation between

the driving power of the engine and the moment of inertia of the fly-wheel the formulas are alike, with the exception that my formula is independent of the rate of expansion in the cylinder, weight of reciprocating parts, etc.

Those who wish to make themselves acquainted with the theory of fly wheels based on periodic fluctuations, as above referred to, will find the subject discussed by Prof. Joseph Torrey, in the AMERICAN MACHINIST of October 20, November 3 and December 15, 1892.

The formula which here shall be given is a complete expression for the conditions necessary for stability in the ordinary centrifugal governor of any description, that is, a formula which is applicable to gravity governors and ordinary shaft governors or spring governors generally. I shall confine myself to an indication merely of how this formula has been obtained, for unless the reader has a desire to investigate the mathematical work or follow the analysis, such matter would take up more space than desirable.

The boundary line of force y_1 would be very nearly a half ellipse if the oscillation was controlled by the reciprocating force y_0 only. Therefore, assuming this to be the case, area y_1 can be expressed correctly by the given quantities, but a frictional resistance equal to force y_0 at a* in combination with the acceleration due to force y_1 will make the boundary line an irregular curve. We may, however, assume that the actual area y_1 bears a fixed relation to the hypothetical area y_1. Let A be the area of force y_1; if this force has no dynamic effect, then we may put $k\,A$ = actual area y_1, where k is an indetermined constant. The frictional resistance which enters the equation of motion is equal to force y_0 at a, and the area of friction is therefore given by the known quantities. Let this area be represented by the letter F, then we must have as a limiting condition of stability $k\,A = F$. All the known quantities of this equation are derived from the engine, fly-wheel and governor, and these quantities are also contained in the equation of motion of the representative point, which is a linear cubic differential equation with constant coefficients. By solving equations with different constants, an equation is found which will satisfy the limiting condition of stability, and in this case $k = 1.75$; then by introducing other constants having a mutual relation determined by $k = 1.75$, it is found that the value of k is very nearly constant within such limits as occur in practice; that is, we may without appreciable error put area $y_1 = 1.75\,A$.

$$\text{Area } y_1 = \frac{12\,g\,.8\,.60\,P\,S\,f\,l\,\sqrt{50\,l}}{16\,\pi\,D^2\,W\,N\,\sqrt{a\,q\,f}}\,k.$$

$$\text{Area } F = \frac{q\,f\,l}{100},$$ and as we must have area $F >$ area y_1, we obtain the following formula for stability:

$$\frac{W\,D^2\,N}{P\,S} \times q\,\sqrt{\frac{a\,q\,f}{l}} > 4{,}524{,}000.$$

W = weight of fly-wheel rim in pounds.
D = diameter of fly-wheel in inches.
N = revolutions of fly-wheel per minute.
P = greatest mean effective pressure per whole area of piston.
S = stroke in inches.
q = greatest variation in speed from light to heavy load expressed in per cent. of mean speed.
a = acceleration in inches per second of the representative point by a force of one pound acting in the projected direction of motion.
f = mean centrifugal force reduced to the representative point in the projected direction of motion.
l = the projected distance between two extreme positions of the representative point corresponding to a variation in speed to q per cent. of mean speed.

It will be noticed that the capital letters designate quantities obtained from the engine, and the small letters represent such quantities as may be obtained from the governor. The constant in the formula has been obtained by calculation, and I have reason to believe that it is somewhat greater than needed. I have assumed that any change in the position of the governor weights will effect an immediate and corresponding change in the driving power; this condition does not exist in an automatic cut off engine, and if the calculation was based on the principle of the automatic cut off a greater constant would be obtained. But there are several conditions, particularly in spring governors, which cannot be taken into the calculation, and which would reduce the constant, and the one I have given is probably too great even for automatic cut off engines. However, I shall leave this constant in my formula until a better one is obtained from experiments, it is correct under the assumed conditions, and it is better to leave it thus than to substitute another constant obtained from incomplete experiments.

It will readily be seen that this formula is of great utility, as it gives an answer to a number of questions in regard to the design of the governor, speed, centrifugal force, inertia, size and weight of fly-wheel, etc., and it affords a means of comparing the efficiency of different governors.

The following is obtained directly from the formula: That q is the most effective quantity, and that moment of inertia of fly-wheel and speed of engine come next in order with size of engine and steam pressure as equally effective factors in the divisor, while next in efficiency comes the acceleration of the governor system, and inversely the amount of motion of the governor weights.

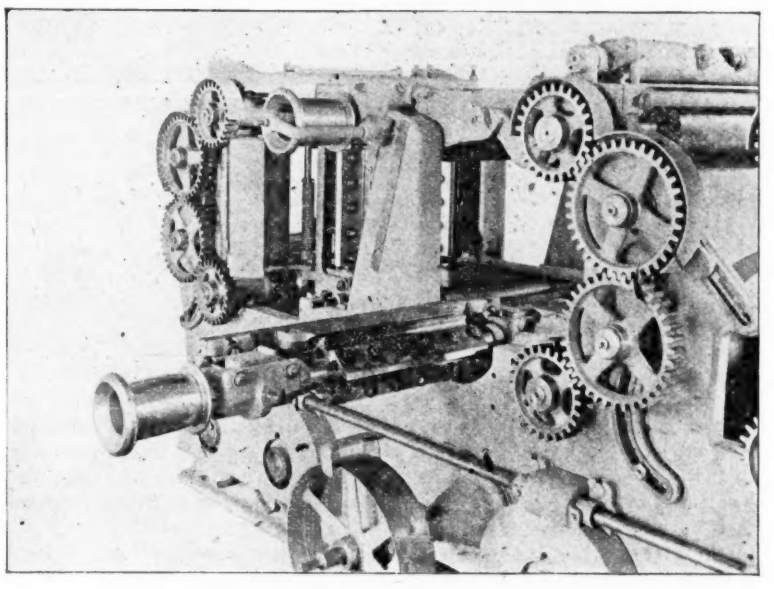
The speed of the governor appears implicitly in the formula for a certain speed must be assumed for the calculation of centrifugal force in a spring governor, and in a gravity governor the speed is obtained from the height of cone. If we have got all the quantities from a certain governor and found the corresponding constant, we may design any other equally efficient governor by using the same constant. In a Watt's governor we may obtain greater stability by increasing the rise of the balls, this will increase l and q in the same proportion, but the exponent of l is $\frac{1}{4}$, while the exponent of q is $\frac{3}{4}$, and the change will therefore be very effective if there is an excess of friction equal to the increase of force y_0, or else with the addition of a pump brake. The formula can easily be applied to the governor, shown in Fig. 23, for the various quantities considered are designated by the same letters as in the formula, and the value of q is obtained from the formula given in the issue of October 19th. It will, by a closer investigation of the formula for stability, be seen that there is a certain value of l for any particular case which gives greatest efficiency, but this value will sometimes be impracticably small. If, for instance, the inertia of the governor weights only be considered we obtain for greatest efficiency $l = 0$; and a consideration of friction and the action of reciprocating parts, etc., would fix a limit below which it would not be advisable to go, and in a gravity governor there must exist a certain relation between the height of cone and the rise of the balls, which should be taken into consideration. In a shaft governor, for instance, the weight of the ball $= e$, and its extreme motion $= l_1$, and the weight of eccentric rods, etc., $= E$, K . . . and the motion of these parts corresponding to the extreme motion of the ball $= e$, k . . . respectively, then for a governor with two balls

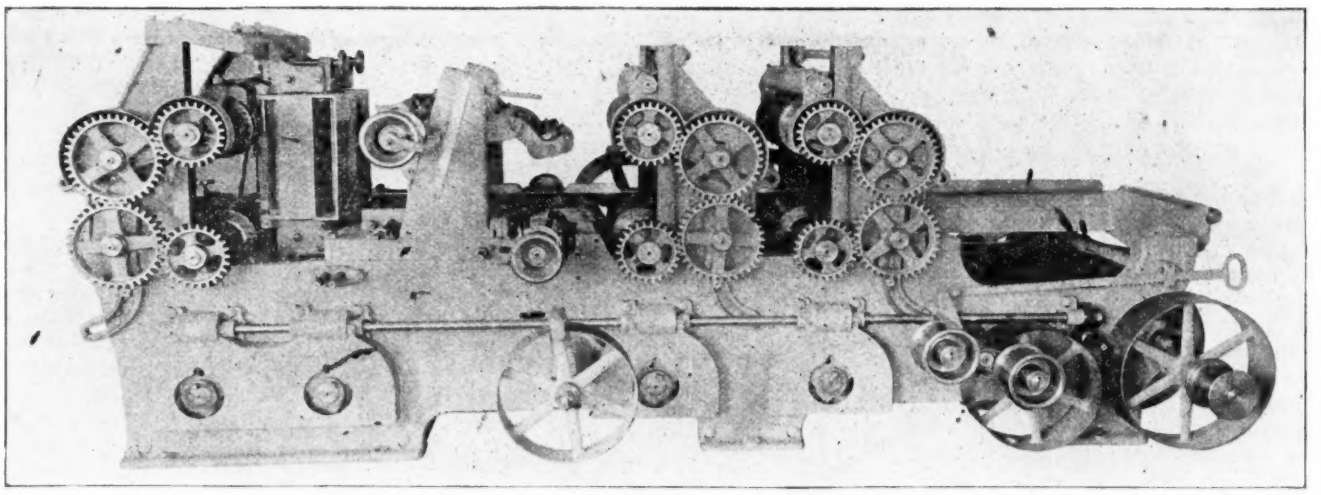
$$l_1 = \sqrt{\frac{\frac{1}{2}\,E\,e^2 + \frac{1}{2}\,K\,k \ldots}{c}}$$

is the proper motion of the ball, for the quickest action is obtained by this value of l_1. It will not be necessary to consider the time of the oscillation when designing a governor, for the stability of a governor depends on the magnitude of force y_1, and fluctuation in speed caused by a sudden increase or diminution in load can therefore not exceed a certain amount if the governor shall be stable, and the extent of such fluctuation will never be too great in a perfectly stable governor unless there be excessive friction or too much resistance in the pump brake. A great deal of direct and indirect information can be obtained from my formula, and those interested in the theory of governors will find it very useful.

I have still something to say about testing governors, the influence of reciprocating parts and unbalanced weights and some recent improvements.

*See December 14th issue.





IMPROVED TIMBER-PLANING MACHINE.

Improved Timber-planing Machine.

The accompanying illustrations are of an improved wood-working machine, which is designed to combine the features of a timber planer and the regular planing and matching machine for either hard or soft woods, heavy or light work. The machine is built to plane either four sides 20 inches wide and 16 inches thick, or 30 inches wide and 16 inches thick, and, if ordered, with center guides, divided rolls and pressure bars, for the purpose of sizing or dressing three sides of two timbers at one time, up to 16 inches by 12 inches.

It has six large feed rolls driven by an improved system of compound gearing. The upper and lower rolls are connected by an improved balanced expansion gearing, producing the most powerful feeding capacity at any desired speed, from 20 to 150 lineal feet per minute. The upper rolls are raised and lowered with the top cutter by power frictional gearing, also by hand, and the top cutter can readily be adjusted separate from the rolls. The lower feeding in rolls and the under cutter are, by a lever at the operator's hand, raised or lowered at will instantly to take any amount of cut on the under side of the timber. Each upper roll has an improved parallel motion and new method of pressure, that is ample and variable at the will of the operator. The feeding out rolls are provided with independent separate adjustment.

The under cutter is so arranged as to be quickly drawn outside the machine, to facilitate the setting, sharpening and removing of knives, etc., and has also an independent attachment for raising and lowering, thus enabling the operator to make the finest possible adjustments; with the lower feeding in rolls it is instantly adjusted while in motion to any desired cut on the under side of the timber.

The top cutter is provided with an improved feeding in pressure bar on the rough surface and improved pressure bar on the finished surface, and with the under and side cutters. The journals are long and large and run in J. J. White's patent journal boxes, that insure perfect bearings and alignment at all times.

The side cutters are both adjusted across the whole width of the machine and are fitted with patent matcher steps and combined chip breaker and shaving hood, and latest improved hold-downs, etc., making a complete and perfect side cutter combination. The chip breaker and shaving hoods are readily swung back out of the way to allow access to the knives for adjusting, sharpening, etc. The right-hand side head being moved by screw shaft and crank across the machine, carrying the guides

with it, and the guides also having independent adjustment, leaves nothing to be desired in the way of adjustment, and at the same time equalizes the wear of the rolls, bed plate, pressure bar, knives, etc.

Having the machine constructed with the under cutter dressing the under side of the timber first, as on the hardwood flooring machine, previously described in these columns, followed by the upper and side cutters at a very short distance, allows of a stronger arrangement of those parts, insures timber being planed square and hardwood flooring that will match perfectly, as it furnishes a true surface for the timber or lumber, which being acted on by the upper and side cutters, secures more perfect work and more easy, rapid and perfect feed.

The upper cutter and rolls have an improved power-raising device, and are also adjusted together or separately by hand.

The under cutter draws out of the side of the machine and with the under rolls has instantaneous adjustment to thickness of cut.

The small cut shows the under cutter drawn out, and the side cutter, chip breakers and shaving hood swung back, exposing the cutters for sharpening, setting, etc.

The machine is 15 feet long and weighs 17,000 to 20,000 pounds. The driving pulleys are 16 inches diameter and 10 inches face, and should make 950 revolutions per minute. It requires 125 feet of 5 inch belting for upper, under and side cutters, and 17 feet 7 inches of 4 inch feed belt. It is made by the J. S. Graham Machine Co., Rochester, N. Y.

An engineer, who now considers himself "too old to begin," recently remarked to the writer that looking back over his life he considered one of the great disabilities under which he had labored was his inability to make a respectable free-hand sketch. This is a matter of greater importance to some than to others, and what he said may not have been much exaggerated. At any rate, it is a matter of a good deal of importance to mechanics, and especially so to machinists. Almost every one knows of some machinist who attends to outside work a good deal who, will bring to the shop such a sketch of what is required as would fill a draftsman's heart with envy. And we know that he gets paid for this accomplishment. Everybody has noticed at school that some boys "take naturally" to sketching forms, surreptitiously, while others never cause their teachers trouble in this respect. It would probably be said of the boy who showed uncommon proficiency in this that he was a genius, but every boy has got enough of genius to learn to do something in the way of sketching, and he should learn it if it requires a good deal of effort. He should be compelled to learn something of it as a part of his common-school education, and if he learns a trade should follow it up during his apprenticeship.

The commuters on the Delaware, Lackawanna & Western Railroad, residents of Montclair, N. J., have formed an organization which is to demand better accommodations and better regard to safety under the penalty of transferring their patronage to the Erie.

Motor-driven Lathe.

The illustration presented herewith represents an engine lathe which originally was driven from a countershaft. This being undesirable it was arranged to be driven from an independent motor in a manner which nearly equals in efficiency and convenience the performance of tools in which the motor is part of the machine.

The motor is belted directly to largest speed of cone pulley and rests on an adjustable base beneath the latter to permit of keeping the belt at proper tension without the necessity of cutting and relacing.

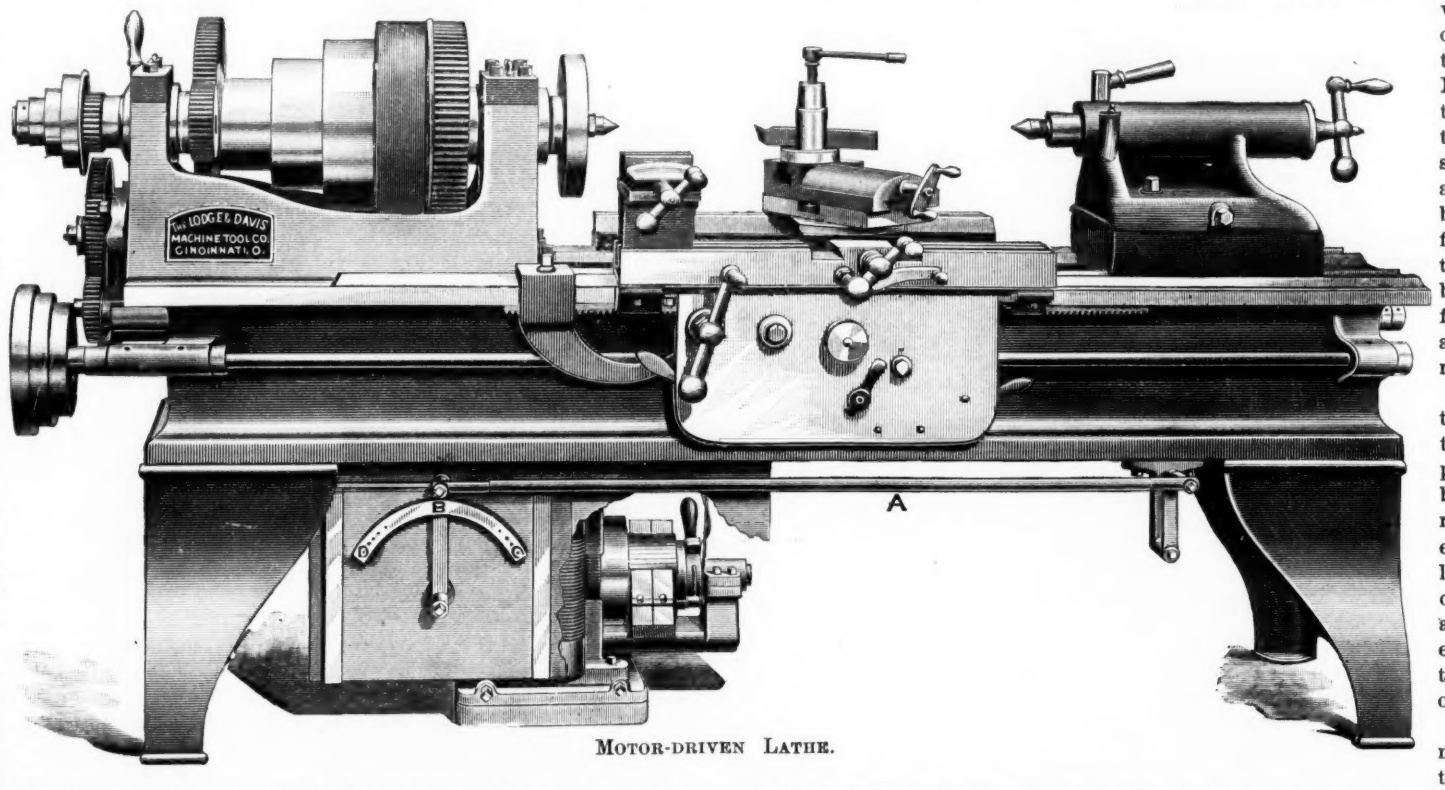
The belt is never removed from its position on largest step of cone, but the speed of motor is varied to suit the requirements of the work to be done in the following manner:

Directly beneath the bed, rod *A*, which extends nearly full length of lathe, is suspended and connected at one end to switch lever. When switch lever is in a perpendicular position the motor is at rest, and the speed is varied in either direction by simply moving rod to the right for forward, to the left for backing motion, the rate of speed being governed by the position of switch lever between the points *B* and *C* or *D*.

When the maximum speed is required the switch lever is placed at *C* or *D*, any intermediate position giving a correspondingly slower motion until *B* is reached and the lathe stops.

This arrangement, while not as desirable as where machines were originally designed to be driven by independent motor, has proven itself very satisfactory in practice, and makes it possible to dispense entirely with overhead transmission in favor of independent driven machinery.

Another advantage which is frequently of importance is that machines may be placed independently of the fixed conditions which exist when shafting is used.



Motor-driven Lathe.

It will be understood, of course, that when in use the motor is entirely covered up and protected from chips and dirt; the engraving showing part of this covering or casing broken away.

The lathe shown was built by the Lodge & Davis Machine Tool Co., of Cincinnati, O., and is running at the works of the Card Electric Motor and Dynamo Co., of the same city, who designed and built the motor.

The lathe is well known to our readers, having been previously illustrated and described in these columns. It embodies their well-known features—screw on the inside of bed, taper attachment, reverse in the apron, and automatic stop to the feed. This company is at present engaged in building a number of lathes in which the motor forms a part of the machine, being placed on the head stock in place of the cone pulley. These lathes will form the subject of an illustration and description in the near future.

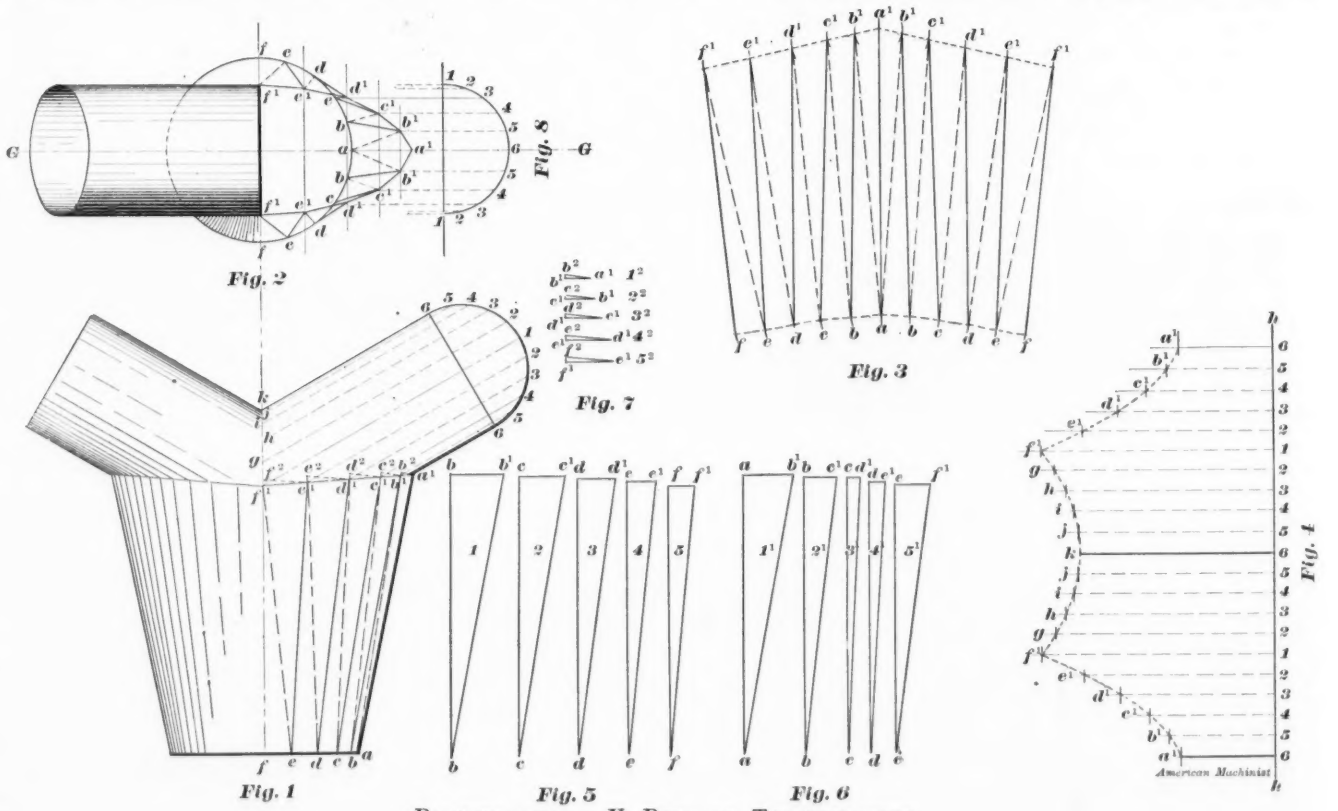
Pattern for a Y Pipe by Triangulation.

By George Guntz.

In the construction of sheet metal work it sometimes happens that a job comes along, especially if it is one in which heavy iron is to be used, which makes some very good men scratch their heads the second time, and then they jump on it with the rule of thumb. If they hit it, all right; if not, well, another piece of stock goes to the scrap heap. Now this article treats on what at the first glance seems to be only an ordinary affair, but when you confine yourself to the conditions, it becomes quite formidable to the average boiler maker.

The problem is to develop the patterns for a "Y" pipe, the two branches to be round having equal areas. The large pipe to fit onto a round pipe, and have an area equal to that of the two smaller ones.

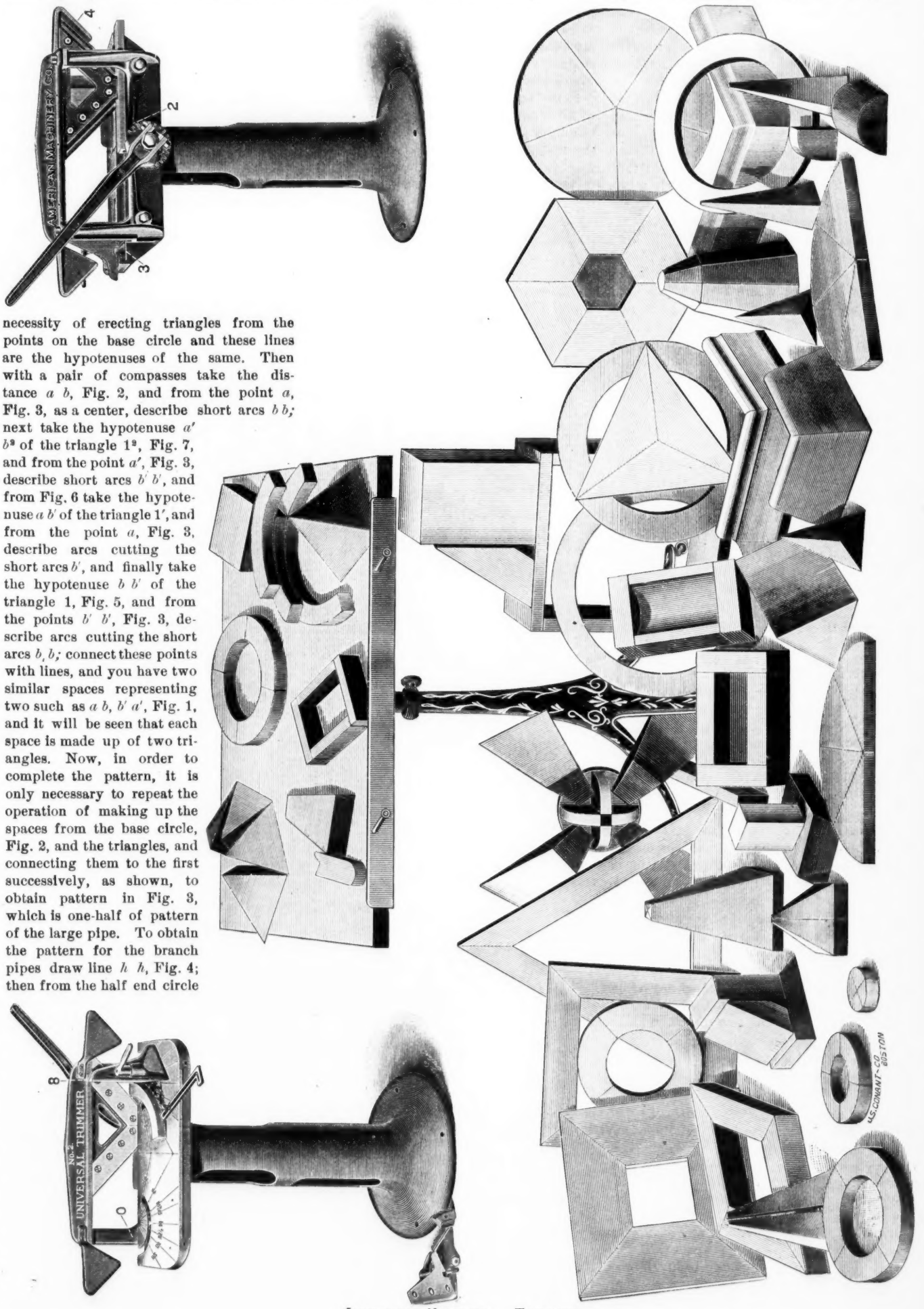
It is absolutely necessary that the end of the large pipe be perfectly round, also that it should be straight across its face. Now it is very well known by those who are familiar with this kind of work, first, that if you take a piece of round pipe and flatten one end, the flattened end will not have the same area as the round end; second, that when you do flatten one end of a round pipe in one direction, you flatten the other end in the other direction; therefore, it is obvious that a straight piece of round pipe won't do to make the large pipe out of, so it looks as if you would have to cut a special pattern for it, and, of course, you would not make the branches without doing the same. Of course there are a great many of your readers who know all about the method employed for laying out a pattern for the branches, but as I have never seen a rule laid down in any of the geometrys into which I have looked, giving a correct rule for developing a pattern for a large pipe to conform to the conditions, I think this



Pattern for a Y Pipe by Triangulation.

article will shed a little light on the subject.

In laying out patterns for any article in sheet metal, it is as necessary to have correct drawings of the article for which the pattern is required as it is to have a correct drawing for an article in cast-iron for which a wooden pattern is required, and always two views and sometimes more. In this case there is required a half side elevation, a half plan and a vertical half of the end of one of the branches, but for clearness of description I have made full side elevation, Fig. 1, a plan, Fig. 2, showing the round end of the big pipe, the oval end where the branches join and the top of one branch, also the vertical half end of branch, Fig. 1, and a horizontal half of the same end, Fig. 8. Now in order to make the side elevation as here shown, you must know how long the flattened end of the large pipe must be, and here you will have to use a little arithmetic. Suppose the round end of the large pipe is 20 inches in diameter, this would have an area of 314 inches, and each of the branches would require to have an area of 157 inches, which would give a diameter of 14.153 inches. Now to obtain the length of the flattened end, you multiply the area of the small pipe 157 inches by 3, and divide the product by the diameter of the small pipe 14.153 inches, which will give you 33.2 inches $\frac{157'' \times 3}{14.153''}$ = 33.2 inches, length of flattened end. Having determined this make the side elevation, or at least half of it, and draw the half circle on the end of the branch as shown in Fig. 1. This half circle is the vertical half of end of branch. Divide this half circle into equal spaces commencing in the center at 1 with the compass and stepping off in each direction 1, 2, 3, 4, 5, 6; then draw lines from these points down parallel with the center line 1 *f'*, cutting the center line *f f* of the large pipe in *k*, *j*, *i*, *h*, *g*, and the miter line *a' f* at *e' d' c' b'* where the branch joins the large pipe. Having done this draw the plan, Fig. 2, first by describing half the circle of the round end of the large pipe on the line *f f*, Fig. 2, and spacing it off in the same number of equal spaces as the half end of the branch commencing on the center *a* and stepping in each direction as *b*, *c*, *d*, *e*, *f*; then drop these points down on the bottom line of the side elevation as *a*, *b*, *c*, *d*, *e*, *f*, Fig. 1, and connect them with the points *b' c' d' e'* on the miter line with lines as shown; also connect these two sets of points by diagonals as shown by the dotted lines, thus cutting the quarter section of the large pipe into triangular pieces. Next construct the upper flattened end of the large pipe as follows: From the points *a' b' c' d' e' f'* on the side elevation, Fig. 1, draw the lines *a'*, *b' b'*, *c' c'*, *d' d'*, *e' e'*, Fig. 2; on the line *g g* describe a half end of the branch as Fig. 8, and space this off in similar way as that in Fig. 1, and from these points draw lines cutting the lines *a'*, *b' b'*, *c' c'*, *d' d'*, *e' e'*, *f f*, making the points *a'*, *b' b'*, *c' c'*, *d' d'*, *e' e'*, *f' f'*; then when these points are connected they will form a curve which is the shape of half the flattened end of the large pipe. Now connect the points on the base circle with those on the curve as *a* to *a'*, *b* to *b'*, *c* to *c'*, etc., also connect them with diagonal lines *a* to *b'*, *b* to *c'*, *c* to *d'*, etc. The next step in the operation is to construct three sets of right-angle triangles as in Figs. 5, 6 and 7; of the two sets, Figs. 5 and 6, the verticals are the same in length and are simply the vertical heights of the points *b' c' d' e' f'* on the miter line above the base on the round end and the horizontals are taken from the plan, Fig. 2, as *b b'*, *c c'*, *d d'*, *e e'*, *f f*; for those in Fig. 6 the horizontals are also taken from the plan, Fig. 2, as *b'*, *b c'*, *c d'*, *d e'*, *e f*; for the third set, Fig. 7, the horizontals are taken from Fig. 2, as *a' b'*, *b' c'*, *c' d'*, *d' e'*, *e' f'*, which are the spaces around the curve. The verticals are taken from the elevation, Fig. 1, as *b' b²*, *c' c²*, *d' d²*, *e' e²*, *f' f²*. These distances represent the height of one point above the other on the miter line as *a'* above *b'*, *b'* above *c'*, etc. Having constructed these triangles, we are ready to lay out the pattern as shown in Fig. 3. First draw the line *a a'*, Fig. 3, then set off on this line the distance *a a'*, Fig. 1. You will then discover the necessity of all these triangles from the fact that this line *a a'* is the only line on the elevation of the large pipe of which you can get the exact length from the elevation. The others are all in perspective and are all inclined in different directions and do not converge in a common center as they would in a cone, hence the necessity of erecting triangles from the points on the base circle and these lines are the hypotenuses of the same. Then with a pair of compasses take the distance *a b*, Fig. 2, and from the point *a*, Fig. 3, as a center, describe short arcs *b b*; next take the hypotenuse *a' b²* of the triangle 1², Fig. 7, and from the point *a'*, Fig. 3, describe short arcs *b' b'*, and from Fig. 6 take the hypotenuse *a b'* of the triangle 1', and from the point *a*, Fig. 3, describe arcs cutting the short arcs *b'*, and finally take the hypotenuse *b b'* of the triangle 1, Fig. 5, and from the points *b' b'*, Fig. 3, describe arcs cutting the short arcs *b b*; connect these points with lines, and you have two similar spaces representing two such as *a b*, *b' a'*, Fig. 1, and it will be seen that each space is made up of two triangles. Now, in order to complete the pattern, it is only necessary to repeat the operation of making up the spaces from the base circle, Fig. 2, and the triangles, and connecting them to the first successively, as shown, to obtain pattern in Fig. 3, which is one-half of pattern of the large pipe. To obtain the pattern for the branch pipes draw line *h h*, Fig. 4; then from the half end circle of the branch, Fig. 1, take the spaces (and as these spaces are all equal, it will be only necessary to set the dividers to one of them) and commencing at the middle of the line *h h*, Fig. 4, step off in each direction the same number as are contained in the half circle. This will give you the distance around the pipe, or what is technically known as the stretchout; then set off all the distances from the line 6 6, Fig. 1, which is the end of the branch, down to the line where the branch joins the large pipe, and to the center line where it joins the opposite branch, commencing with 6 *k*, and setting this distance on 6 *k*, Fig. 4, then 5 *J*, and setting this on the lines 5 *J*, and 5 *J* on each side of the middle, then 4 *i*, then 3 *h*, and so on, until you have transferred all, including 6 *a'*, and connect the points with a line drawn free hand, but always bear in mind that any laps that may be needed must be allowed for on the outside of this pattern.



IMPROVED UNIVERSAL TRIMMER.

Improved Universal Trimmer.

We present herewith an engraving giving front and rear views of a universal trimming machine with some specimens of the work for which it is adapted.

The machine is of a type with which our readers are familiar, and is especially useful to pattern makers.

As will be perceived, the machine stands upon a substantial iron column with broad base, permitting it to be placed in any convenient position, and the machine proper swivels upon this column, so that it may be readily turned to the position most favorable for the workman in point of convenience of operation or light.

That degree of rigidity necessary for doing accurate work on such a machine is secured by adding somewhat to the weight, while at the same time ease of operation is secured by counterbalancing the lever and

The existence of a partly constructed tunnel under the North River is again brought to public notice by the effort in England to raise the money necessary to complete the work. Whether or not this effort will be successful remains to be seen. A good deal of the work has been done, in fact, it has been estimated that only $1,000,000 is required to complete it. The tunnel proper was to have been a little more than one mile in length and 18 feet in diameter.

arranging the slides, pinion and rack so that they cannot possibly become clogged with chips or dust. By a slight lateral movement the lever may be disengaged from the pinion and may then be shifted to any convenient position, irrespective of the position of the knife.

The gauges are held in position by means of a circular T-slot, which is milled in the face of the table, and the arrangement is such that the extreme end of the gauge is always as close as possible to the knife, and never changes its position with respect to it. The gauges are faced with pieces of tool steel which are adjustable. As indicated by the engraving the gauges may be set at any angle from 35° to 135° (measured between face of knife and face of gauge), thus providing for a very wide range of angles, and the outer edge of table is planed so that a bevel square may be applied to it for setting the gauges to an angle taken from the work, or to one not provided for by the lines marked upon the table.

The inner face of the upper guide does not project beyond the knife, but is planed true and just flush with the knife, so that in the case of work where a piece has been glued to the bottom of a finished piece and left to project for subsequent finishing this planed surface acts as a gauge and enables the projecting portion of the added piece to be accurately trimmed.

The knives are made of the finest tool steel, are very thick, ground on both sides accurately, and are interchangeable on different machines.

An auxiliary and detachable gauge stop is also used, which may be fastened to either the regular side gauge or to the bed of the machine, and is valuable as a stop in cutting the segments of a circle or in work requiring several pieces of a size.

This machine is built by the American Machinery Company, Detroit, Mich., and can be seen also at their branch house, 11 Old Hall street, Liverpool, England.

Positive Circulation Economizer.

The accompanying engraving shows the construction of an improved economizer such as are often used in connection with large steam plants for heating the feed water before it enters the boilers; the heat of the flue, or uptake gases, being utilized for this purpose.

The economizer shown is the invention of Mr. L. J Hirt, Master Mechanic of the West End Railway Company's system in Boston, and is the outcome of his experience with similar devices both in this country and in England; in which latter country they are extensively used.

As ordinarily constructed, though there are a great many vertical tubes through which the feed water is supposed to pass on its way from the pump to boiler, they are so connected at bottom to a main pipe, that it often happens that owing to difference in frictional resistance or some other cause, the circulation may be confined to a very few of the tubes—perhaps to two or four of them—which, of course, greatly reduces efficiency.

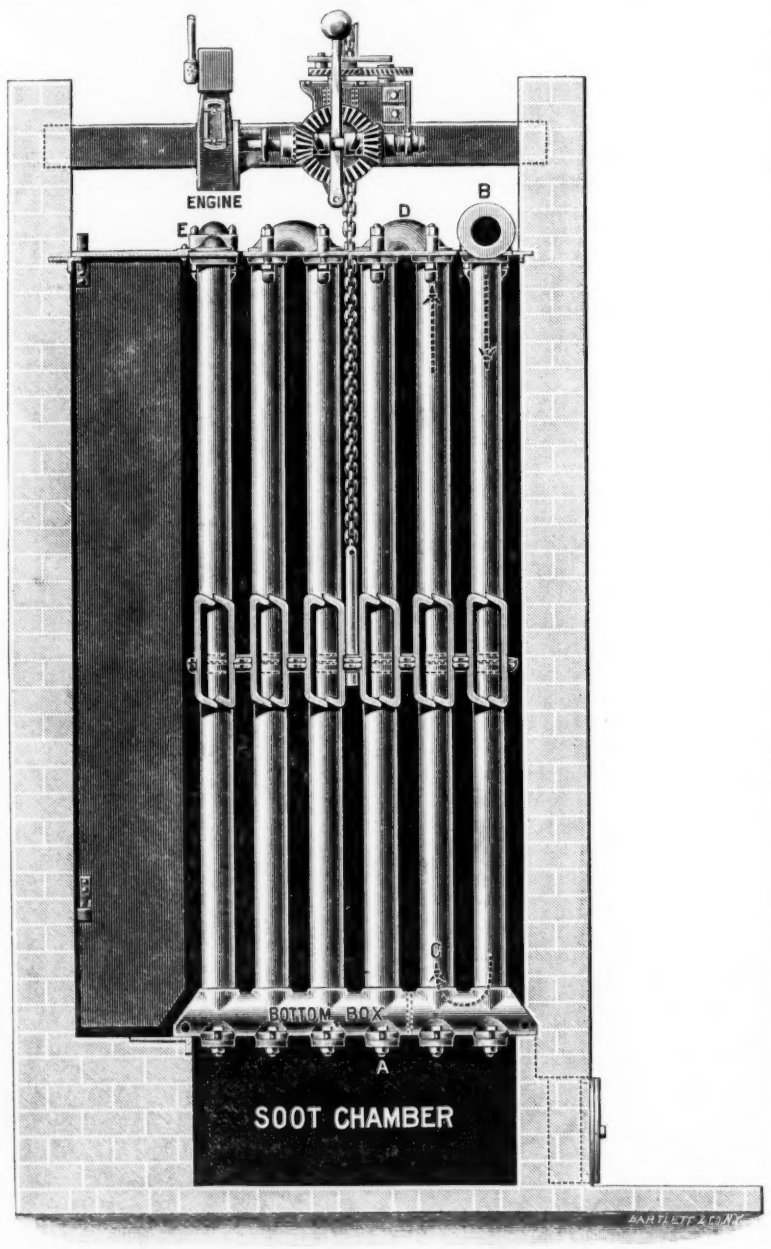
In the economizer shown this difficulty is obviated, the construction being such that the water is fed into one section of the economizer at *B* passing downward through one pipe—turning in its course in the "bottom box" at *C*, ascending the next pipe as shown by arrows—and is again forced to turn its course through the bend *D*, circulating through each pipe in a section, there being a partition or cut-off in the bottom box, as shown by dotted line between second and third pipes. After the water has traversed all the pipes in the first section it is forced to pass through bend *E* to the next section, and this operation is repeated in each section until it passes the entire nest of pipes.

To avoid the danger of cracking of the various pipes by being held rigidly in top and bottom boxes, there is no rigid top box, the bends forming the connections for the pipes at the top are not connected together, there being a space of ⅛ inch between them to allow for expansion.

It is often necessary to clean the inside of the pipes, also to remove broken ones. This can be readily and easily done by taking off the caps *A*, on the bottom box, and removing the bends *D*. The packing used being copper grooved rings that allow "making up joints," without any gaskets or heads, and can be taken off and again secured in place many times without removing the packing ring.

The driving gear has small engine directly attached, and this gear is removed from contact with the hot parts of the economizer, thus making it less difficult to lubricate.

In this economizer there is a total length of 2,016 feet of pipe, through all of which the water *must* pass on its way to the boiler, and the efficiency is correspondingly higher than in cases where it is possible for the water to reach the boiler after going through only, say, 25 feet of pipe.



Positive Circulation Economizer.

The device for scraping the vertical tubes and keeping them clear of soot will be readily understood from the engravings.

This economizer is made by the Consolidated Economizer Co., 8 Oliver street, Boston, Mass.

Three or Four Cutters in Die Heads.

Messrs. Hill, Clarke & Co., of Boston, not long ago received the subjoined letter, from a manufacturer of machine tools in Manchester, and have suggested to us that it might be well to present it to our readers, as if we are wrong in this country in respect to the number of cutters used in our die heads, we ought to know it, and, in any event, some discussion of the matter and of the reasons for the difference in practice might be instructive. The letter referred to is as follows:

Manchester, Jan. 19, 1894.

Messrs. Hill, Clarke & Co.,
156 Oliver Street, Boston, Mass.

Dear Sirs: We are in receipt of your letter of the 22d ultimo, and thank you for your catalogue, which is to hand at the same time.

We are somewhat amused at the surprise expressed as to the use of three dies only in bolt screwing. We are well aware of the opinion held in the United States as to the three and four-die machine, but we are equally convinced from a very wide experience that it is an *utterly* fallacious one, in fact, the experience in this country of all engineers with both three and four die machines is so decisive that no one would accept a four die machine, except in the case of thin tubes where it is necessary not to put too much work on any die, and so distort the tubes.

Whether the climate has anything to do with it or not, we do not know, but certainly in this country the four die machine has been tested and discarded years ago, and we are quite convinced that the boasted advantages of the four-die machine do not really exist.

If all dies are equally dull, the effect is quite the same in either the three or four-die machine.

If one die only is dull, the effect in a four-die machine is to throw all the extra work on the *one* opposite, which then cuts away more than it should, and so produces an untrue bolt. If one only in a three die machine is dull, the extra work is divided between *two others*, and the work is even, truer than in a four die machine.

At any rate, whatever the theory, the best practice fully confirms the decided advantages of the three over the four-die machine.

The same remarks apply to taps with three or four grooves.

In six of the largest cities of Europe the loss from fire last year was 47 cents per capita; in New York it was $2.80.

LETTERS FROM PRACTICAL MEN.

The Draftsman and the Machinist.

Editor American Machinist:

In reading your paper of January 25th I ran bang up against an article by "Easy Way," in which he calls down in good shape the "artistic ornaments of the machine trade." I suppose he refers to us poor snips of draftsmen, and I think we have stood it long enough. From his tone I suppose he is one of those machinists, and if I knew where he could be found, I would get my war paint on. Of course, we are of no earthly use, but then, a well regulated machine shop doing business must make a show, even if they do have to keep a few costly ornaments around. I happen to be one of those fellows who can "measure and figure," and for the past twelve years have been making "queer tangles of marks and circles," etc., but in all that time have not attained that degree of perfection that I could be "cock sure" of everything. I think it was Professor Sweet who said, "There is nothing quite so easy as it seems, but making mistakes," and the draftsman realizes this as much as any one. When I look back over my checkered career, and count up the successes and failures, there is not much of a margin on either side, but this does not cut such a figure, for with every failure came a valuable lesson. Many a job when finished will pass muster but to the eye of the one who created it, and gave it form, etc., there is always something lacking to make it perfect. Many times after having spent days at devising some scheme, I have had one of those machinist fellows come in and look over my shoulder, saying, "That was not right: it should be so and so," probably the very thing I had tried in vain to make go. It is a very easy matter to suggest changes, and I would say right here to "Easy Way" that perhaps he has heard that "hind sight" is easier than "fore sight," for I do not doubt but he is blessed with some of the former.

The careful draftsman never has a clear conscience; even in his idle hours, if they may be called so, the ghost of a possible bull is constantly appearing to him. Why is it that in every shop there is generally a feeling, not just harmonious, between the drafting room and the machine shop proper? Is not one just as important as the other? And is not one just as liable to error as the other? I was amused, a short time ago, at one of those "fellows" who handle the hammers and files and "Munkay-wrenches." He was attempting to dress out a piece of work to template, and after spoiling two or three castings, gave it up as a bad job, and this same man had been at the business "nigh on to thirty years," and delighted to stand around and tell you what wonderful things they used to do. Shortly before that, in another shop where I happened to be at the time, a young man, who claimed to be an all-around machinist, was set to chipping a keyway in the end of an engine shaft, but he was discovered by the boss, shortly after, trying to make a corkscrew of the shaft. Of course there are bad pills in every business, and I suppose we are the worst. I am a little sorry for what I have said, and for fear "Easy Way" will find where I live, I will let up and respectfully ask him to consider the source, as Pat did when the ass kicked him. A practical man is a good article, and a little theory mixed in makes him a better one. I do not want "Easy Way" to think that the draftsmen are habitually getting their "wagon wheels" and "worm fences" in an entangled condition, but that it is human to err.

The Tramp.

To Make the Castings Sound.

Editor American Machinist:

Please accept our thanks for the many opinions from "Practical Men" to which you have helped us through your columns, in reply to our brief letter of inquiry in your issue of January 18th, as to what makes the holes in our castings.

All agree that the difficulty is with our cores or molds and not with the iron, but

we are interested in the variety of remedies prescribed for our case. They may be briefly summarized thus :

1st. Avoid blacking and facing in cope.

2d. Create pressure of iron by heading up the molds.

3d. Create air pressure in molds by using small risers, or none at all.

4th. Pour with iron as hot as possible.

5th. Flow iron through the mold after it is full.

6th. Clean the chaplets and protect them from rust.

7th. Be very careful in venting cores.

8th. Use dryer sand in cope. (The last comes to us from the party of whom we bought the iron.)

Now, these are all good practical points, and it is the knowledge of such that makes a really competent molder. But all of these and more we have tried thoroughly, and most of them we are using to day, but the holes do not entirely disappear.

Now, with your permission, we will reply to our own query, and, for the sake of variety, will take the ground that the trouble is, or at least may be, in the iron.

Our first question was, "Is it possible for the defects described to arise from the quality of the pig-iron we use?" We say boldly, yes. Our holes are undoubtedly "blow holes," that is, holes formed by the passage of gas, of some kind, through the liquid iron and caught and confined in it when the iron "sets." The different kinds of blow holes referred to by Mr Gilmour, in your issue of February 1st, are caused mainly by the different conditions of the iron when the gas passes through it. If these gas bubbles pass up through the iron when it is in a very fluid state, they will flatten out against the cope (if they cannot pass off through it) same as the bubble in a spirit level, and form the holes described in our first letter. On the other hand, if the iron has lost most of its fluidity when the gas passes up through it, it will not have power to close up entirely after the gas, and therefore leaves little vertical holes in the iron when it sets, and sometimes the iron is so nearly set that the gas can get only part way up through it, and then we find the blow hole further down in the casting.

Our holes, then, are blow holes, and other authorities unite with Mr. Gilmour in saying that sulphur in the iron tends to cause blow holes, and who knows but our iron has too much sulphur in it, and if we used a better grade of iron the holes would disappear? Again, it is a fact, as referred to in our first letter, that our pig-iron is full of blow holes of all kinds and shapes—two or three times as many as appear in ordinary pig-iron. Now, will your correspondents say that these are caused entirely by some condition of the molds or "pig beds" in which the iron was cast, or do they indicate something as to the quality of the iron?

Our second question has not been referred to by your correspondents, namely, "May the holes come from improper melting or pouring?" Not *do* they necessarily come, but *may* they come from bad cupola or ladle practice? This, like the other, is a fundamental question, and we reply yes, they may. It is well known that sulphur in the fuel may be imparted to the iron in process of melting, and perhaps our fuel is loaded with sulphur, and this makes our iron bad and causes the holes. Sometimes the iron—when it is first drawn from the cupola—will sputter and boil in the ladle, reminding one of the old-time mush pot when the mush was thin and the fire hot. Now, we take it that this agitation is due to some kind of gas in the iron that is thus coming to the surface and escaping, and if the iron were poured while in this condition it might cause the holes of which we are speaking.

Again, when we break the iron that is left in the runner box, after pouring these boilers, we find it full of blow holes, which was not the case formerly when we used a different brand of iron and seldom had a blow hole in the castings.

We may add that Mr West in his "Molders' Text book," page 213, has very concisely described our holes as "smooth concave indentations," and says they are caused by a "gas cushion." His remedy is less sea coal and more pressure.

Will be glad to hear further from your readers on this subject. W. H. DRAKE.

Molding a Double-arm Split Pulley.

Editor American Machinist:

The following method of molding a double-arm split pulley, 12 feet in diameter by 4 feet face, and weighing 29 000 pounds, was successfully adopted recently in a shop where the cranes were not strong enough to lift either the outside or inside of the mold—a method usually adopted in the case of pulleys of wide face :

A plate having a tapered hole to receive a spindle about 8″ diameter by 6 feet long, as shown in Fig. 1, was bolted securely to a bed of masonry. A pit 15 feet in diameter and about 56″ deep was dug around the spindle, and a curbing 30″ deep was placed around, leaving a space of about 12 inches inside of the curbing around the rim. The curbing was made in sections of cast iron, bolted together, and sand fitted in around the outside. The bottom of the pit was carefully rammed, and a sweep was used made of a board shaped on the bottom edge to sweep the lower end of the hub and rim and bed upon which were laid the lower arm cores. The sweep was fastened to a casting on the spindle, and was adjusted vertically by means of a split collar placed on the under-side of the sweep casting. A piece of board was fastened to the outer end of the sweep about 8″ wide, and extending below the sweep about 2″, and directly below the position of the rim. The bottom of the pit was made with black sand, and carefully swept with the piece in place, after which it was removed and the space made by it filled with green sand facing, working it until it was of a uniform hardness. The other surfaces were swept at the same time, and the sweep and collar removed, and a pattern of the hub placed on the spindle; dry sand facing was rammed around and level with the under side of the arm cores. The sweep for the rim was then put in position to set the cores, and the cores which rest under the arm cores and form a portion of the rim were placed in their respective positions, and the lower arm cores were placed above them. The arm cores were made in a box and strengthened by a grid, and the cores were pasted together and put in position without clamping.

The small cores between the arm cores next to the rim were placed next, and similar ones placed at the hub end, and the upper arm cores placed upon them, and finally the small core above the arm core next to the rim The space between the arms was filled by three cores, made in a similar manner to the arm cores, and fastened by a wire to stakes driven into the bottom of the pit. The sweep was then removed, and the joints in the cores well scratched and filled with core sand and lead mixed soft, blacked and dried with a hanging stove. After it was dry, the bottom was dampened, the rim-sweep adjusted, and the outside of the rim rammed up with green sand, and the sweep and spindle removed; the space around and between the arm cores was filled up with sand, and dry sand rammed around the hub pattern. A cope was used to form the top end of the hub, which was of dry sand. After the cope was removed, the hub was drawn and the mold blacked and dried by a hanging stove. The cope was replaced and an old ring plate placed around and on top of the rim cores; after being properly weighted the pulley was poured in the usual manner, at the hub by means of basins, the mold being open at the rim; about 2½″ extra face was allowed for cutting off. A core 1 inch thick was used to split the hub, and the rim was split in the same manner, except 1¼″ was left at the outer and ¾″ at the inner edge for breaking, as shown in the plan, Fig. 3 A more satisfactory piece of work could hardly be expected. E. J. CONDON.

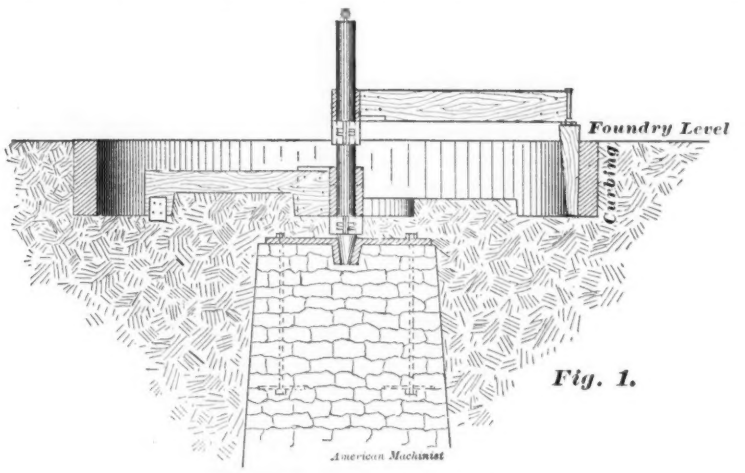


Fig. 1.

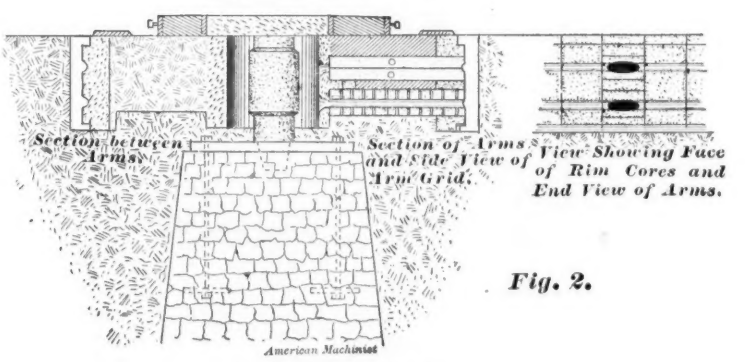
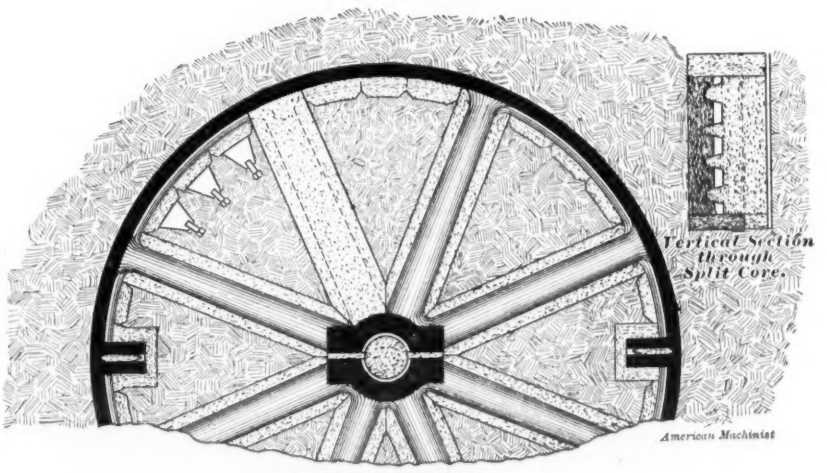

Section between Arms.
Section of Arms and Side View of Arm Grid.
View Showing Face of Rim Cores and End View of Arms.
American Machinist

Fig. 2.



SECTION AT ARMS.
Showing manner of holding cores between arms.

Fig. 3.

MOLDING A DOUBLE ARM SPLIT PULLEY.

The Insurance Trust.

Editor American Machinist:

There is much talk about imposition upon the people by trusts, by the sugar trust, oil trust, carpet tack trust, coal combination, and others, but there is one trust that is as great and close a private monopoly as any of these, although it has not attracted general attention. All the insurance companies are combined into a trust that dictates the price of this necessity at its will.

See how the grind works. I have been paying a rate of $1 60 on my Philadelphia gear shop tools and stock, and now that the prevailing depression has cut off some of the business of the insurance combine, and threatened the fat salaries of its officers, they suddenly raise my rate to $2 70. That rate I must pay or insure myself, and I have spunk enough to accept the latter alternative

When remonstrated with, they have their excuse ready, that my rate has been raised so many cents on account of the height of the building, so many cents because there is no watchman, so much on account of this, and so much for that, while the facts are that the building is no higher than always, there never was a watchman, and this and that are precisely the same now at $2 70 as they have been at $1 60.

The only and the real excuse for the squeeze is that times are hard, and the combine must make a raise some way or other, or else share the business depression with the rest of us. Manufacturing concerns are studying economy as they never have before, and are cutting off a vast amount of wholly needless insurance, and this nips the insurance trust, and forces it to raid those that must pay, or miss their accustomed income.

Talk about oppressive trades unions of workingmen! The gentlemen of capital and ease are the greater and more successful sinners in that direction, and the only remedy is to pitch the tea into the harbor, and go without insurance for a while.

Lexington, Mass. GEORGE B. GRANT.

Fluting a Roll.

Editor American Machinist:

An easy way to flute the roll mentioned in Question 57 (issue of February 1st) is with a knurl held in the tool-post, pressed against the roll as it turns in the lathe and fed along by the feed the same as in turning I have done steel rolls 6″ diameter, 3 feet long, 36 to the inch in this manner. R. KAST.

New York.

Mounting Blue Prints.

Editor American Machinist:

I noticed in your last paper that C. H., of Decatur, Ill., has had trouble with his blue prints, or, rather, the cardboard.

I think I have a good remedy. Instead of using cardboard, get sheet-iron (about No. 32) and use it instead of cardboard. If blue prints are very large get sheet iron heavier. It will not warp or wear out; if it gets bent, straighten it out; but if cardboard is bent it is gone. Sheet-iron when once used, I think, will always be used.

R. C. O.

The air of this country seems to have a beneficial effect on Italians, at least they are moving against the padrone system by which the latter pockets just about half the money paid to laborers by the city of New York, and gets a big bonus for supplying contractors and corporations with laborers. The whole padrone system is scarcely removed from slavery, and is much worse in some respects.

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NEW YORK, MARCH 1, 1894.

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A Perpetual Motion Machine Gibbet.

New York papers of recent date contain accounts of the suicide by hanging of a machinist who for some years worked at the roundhouse of the New York Central road. He was a German and years ago conceived the idea that he could construct a perpetual motion machine. He worked on this machine for years, and, finally, contrary to what usually occurs in such cases, became convinced that the machine would never work. In discouragement he then hanged himself upon the machine.

We can conceive how an uneducated person, unfamiliar with machinery and mechanical matters, might, for a time at least, persuade himself to believe that perpetual motion is possible, but how any machinist can for a moment entertain any such an idea is more than we can understand. One of the fundamental facts connected with machinery is that every part of a rigidly connected mechanism moves with a force inversely proportional to its rate of movement. This one fact thoroughly grasped and understood will forever prevent any attempt upon the part of him who does grasp and understand it to devise a perpetual motion machine; and it is a fact which it is so easy to thoroughly grasp and understand that it would seem as though any machinist ought to thoroughly learn it during his first year at the business, or, say, the first time he observes and really thinks about the motions of the different parts of a punch-press, or of a back-geared lathe.

Making Experiments.

The difficulty of making an experiment that shall satisfy others has occurred very forcibly to us of late in connection with the experiments by Mr. Willis, made some time since, with reference to the use of long and short pipes for indicator connections. We have received several communications on the subject that, while they were entirely convincing to those who made them, would fail to settle the matter in the minds of others because of inexactness. The conclusions to be drawn from some of them would be so fundamentally opposed to those naturally drawn from others, that nothing but the most exact conditions and the exact statement of conditions, would be convincing, or even in any way satisfying. We do not despair of yet getting the record of further experiments from which very interesting conclusions may be drawn, and especially as to why the evidence appears to be so contradictory. It may be remarked without offense that only one experiment should be tried, at the same time. A good many people have been disgusted with their own experiments, made at a good deal of expense, because two or three things had been tried at once. Such was the case with a man who, at one time, was well known in railroad circles. He made some quite elaborate experiments to determine the saving in the use of balanced slide valves, and never ceased to condemn himself for the fact that, summing up at the conclusion, he was entirely unable to form any intelligent conclusion in what he really started out to determine, because, as he expressed it, he "tried two experiments at once."

We notice in some quarters a disposition to use the term "machinist" in a new sense, *i. e.*, to indicate those who construct or manage that variety of machine by which the nomination and election of certain candidates are brought about regardless of the wishes or preferences of citizens who are popularly supposed to have some voice in the matter. We object to this use of the term because we think a name to which so much of honor and glory attaches should not be so misused and confounded with those who, instead of being engaged in an honorable and extremely useful occupation, are engaged in one which is of just the contrary character. We have always regretted that the term "machine" had been applied to that form of political organization which is designed to bring about certain pre-arranged results contrary to the real wishes of those who do the voting, though we must concede that the term so applied is, in a sense, very appropriate. But "machine man," as a designation for one who constructs, or runs such a machine, will do as well as "machinist," and we would much prefer to see it used.

The remarks of a well known mechanical engineer at one of the recent meetings for discussion, to the effect that triple expansion engines of large power were in use that required sixteen or seventeen pounds of water, and that too much attention has been given to the adding of cylinders, and too little to using refinements of steam engineering that would bring about better results with fewer cylinders, call attention to an undoubted fact. Questionable construction is sometimes employed, the feeling being, apparently, that the extra cylinder will at least make good other losses. But his remarks naturally lead to another view of the matter, and that is, that in many of the elaborate tests the conditions seem to be in favor of the multi-cylinder engine as against the fewer cylinders. In other words, there are two sides to the matter; the conditions of tests are seldom so nearly alike that really intelligent comparison can be made. In other words, such comparison as shall demonstrate beyond reasonable doubt the actual economy of adding cylinders. There is room for experiments that should help to a better understanding of the whole matter, and so save a good deal of the groping along, all the while a good deal in the dark.

Machine tools may be classed, in the main, as slow-running, long-lived machinery, which is unfortunate in one respect. They actually last too long for the good of the user. There is an attachment for old machine tools that keeps them in service after skill in the art has produced something so much better that they ought to be put out of the way. The old lathe that did good work thirty years ago, is good to day, because it was good then, so the argument goes; and so it is with a hundred other things. There are still shops using square shank drills because they have always been used, and because things in general are fitted to them. It often happens that the old tools and the old ideas prevail until new men build the new shop and equip it with new tools and new ideas. The old shop often dies because of its burden of old tools.

A large proportion of the cities of this country are in a chronic condition of complaint at the exorbitant price charged by the gas companies for gas. That the complaints are well founded is proved by the citation of instances where, through the restraining influence of legislation, the price is much lower. This high price is bad where workshops are lighted by gas, and it is particularly bad for the small gas-engine trade. The gas engine is one of the most popular means of furnishing small power, and can very well hold its place if it has a fair chance in the price of gas. But, handicapped as it is in many cities, it is at a disadvantage that does not belong to it by right; unnecessarily high price for gas is a detriment to a hundred small manufacturing interests in a large city, and it looks as if the outcome would be that cities will find themselves compelled to furnish gas as well as water to the citizens.

Year by year the machine shops that build everything grow scarcer. Competition crowds them out of business. Steam engines, machine tools, mill work, and the like, do not harmonize well enough to meet the present conditions. The fact is that a good deal of energy is required to get along satisfactorily with a business in either, and when the energy in a single shop is spread out too extensively it gets thin in places. A shop attempting all is likely to find it can buy either for less money than it can build. Following shop practice in this respect the mechanic and the mechanical engineer become specialists. The man who can do everything, or who knows everything, is not in demand. In the various branches of the machine business there are different requirements, and, as competition grows fiercer, the division in skill and art becomes more subtle. Whether or not this division and subdivision is better, makes little or no difference. It is the way in which the world is moving and the individual has no choice but to move along with it. It is an iron law.

According to correspondents of *Iron* from different European centers the iron and steel trade throughout France is brisker than it has been and prices stronger. Some of the railroads are ordering more freely, and private firms are in some instances giving large orders. Many furnaces are in blast, though a good many are still idle. In Germany the conditions are about the same. In Belgium there does not appear to have been much advance. On the whole it seems that there has been material business improvement in Europe.

Literary Notes.

WHAT AN ENGINEER SHOULD KNOW ABOUT ELECTRICITY. By Albert L. Clough, E. E.

This little book is No. 4 of the "Mason Regulator Series," and, as indicated by its title, is intended to give to the engineman that knowledge of electricity that will help him in overcoming the difficulties ordinarily met with in the management of power plants in which electrical apparatus constitutes an important and constantly increasing part. Besides this information—which is plainly given and accompanied by illustrations—there are also the "rules and requirements of the Underwriters' International Electrical Association, for the installation of electric light and power." The book is devoid of difficult technicalities and mathematics and gives much useful information and practical "pointers" for enginemen and mechanics. The book is 4½"x7", 108 pages, flexible covers. It is published by the Mason Regulator Company, Boston, Mass. Price, 50 cents.

We have received No. 41 of "Shoppell's Modern Houses," which contains 50 colonial designs of houses, varying in cost from the simplest cottages to elaborate houses, besides 26 designs of other styles, together with much other information pertaining to building. It is published by the Co operative Building Plan Association, 63 Broadway, N. Y.

We have Volume I. of the "Proceedings of the Society for the Promotion of Engineering Education." This new society held its first meeting at Chicago last August, and it constituted Section E of the World's Engineering Congress. This first volume contains valuable papers presented at the meeting by eminent engineering instructors on topics of the utmost importance to all who are engaged in this line of work. These papers were freely discussed when presented, and this discussion is given in full. Amongst the papers are those bearing the following titles: "The Ideal Engineering Education," "Requirements in Mathematics for Engineering Education," "Comparison between American and European Methods in Engineering Education," "Equipment of Engineering Schools," "Teaching of Graphical Methods," "Original Research by Students," "Drawing for Engineering Students." All the papers have evidently been prepared with great care, and the volume is well printed and bound. It is uniform in size with volumes of proceedings of the other technical societies, and may be had of the Secretary, Prof. J. B. Johnson, Washington University, St. Louis, Mo., $2.50.

HOW TO FRAME A HOUSE, or Balloon and Roof Framing. By Owen B. Maginnis.

This is a book in pamphlet form, which is intended for the use of the practical house builder. Its author has been teacher of

drawing at the New York Trade School, and has profusely illustrated his book with drawings showing how to lay out, frame and raise timber houses on the "balloon principle"; also an easily understood system of roof framing. The book is published by its author at 356 West 124th street, New York City. Price, $1.

An innovation in the *Patent Office Gazette*, recently ordered by Secretary Smith, is the publication of a list of patents expiring during the week. This will no doubt be found very useful in drafting rooms and other places where the question of the right to use a given device is constantly coming up.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(101) J. C., Newark, N. J., writes: I have a new razor which I am advised to put in oil for 24 hours before using. Do you think this will do any good? *A.*—No.

(102) F. V. F., Kewanee, Ills., writes. Please inform me in which numbers of the AMERICAN MACHINIST the articles relating to tool chests were published. *A.*—May 7, 14, 28; June 11 and July 2, 1891.

(103) H. J. N., Fitchburg, Mass., writes: I want to draw sulphuric acid through a cock or valve. Can you give me a mixture of any material except glass which the acid will not affect? *A.*—We know of no metal, excepting platinum, which this acid will not affect.

(104) Mr. H. J. Gielow, Engineer and Naval Architect, New York, calls our attention to a very palpable error in our answer to Question 58, current volume. In that answer we gave 10 square feet per horse-power cooling surface for a keel condenser. The usual allowance is about $\frac{1}{4}$ of a square foot, as pointed out by Mr. Gielow, and for which we thank him.

(105) Inquirer, Brooklyn, N. Y., writes: Please give me a simple rule for computing the size of steam chest of a small engine, say, a hoisting engine with cylinders 6x10 inches. Also, what is the average piston speed for the same engine? *A.*—The only rule for determining the size of steam chest is to make it large enough, and no more, for the valve and its travel, and allow a passage sufficiently large for the steam to surround it. The average piston speed for this class of engine is about 400 feet per minute.

(106) J. L., Brooklyn, N. Y., writes: Please give me a drawing of a double-acting slide valve cylinder. If you have none, please let me know where I can obtain one, and the price. *A.*—You will find a good illustration of cylinder and engine in our issue of October 12, 1893. This cylinder is designed for a balanced slide valve. For a plain slide valve the width of the exhaust port should be reduced so as to bring the steam ports closer to each other. You will find drawings of cylinder designed for a plain slide valve in the "Elementary Manual of the Steam Engine," by A. Jamieson. The price of this book, if our memory is not at fault, is $2.

(107) J. L. A., South Superior, Wis., writes: We have an open feed-water heater, 56 inches diameter and 12 feet high; we wish to make a coil heater of it, or one in which the feed water passes through a system of pipes or tubes in the heater so as to deliver the water to boilers at a higher temperature. What we would like to know is, what do you consider to be the best arrangement? *A.*—We would be in a better position to answer your question if we had a drawing of the heater as it is at present. From the data you have given we should put a hollow cast-iron head at each end of the heater, and run straight copper tubes, say, $\frac{3}{4}$ inch diameter, from one head to the other and pack their ends in the inner walls of the heads so as to make steam-tight joints. The exhaust steam should enter the side of the shell and an outlet provided for the water of condensation. The feed water passes through the tubes; the heads can have partitions so as to cause the feed water to flow two or three times through the tubes on its way to the boiler. Care should be taken to give the steam as free a passage as possible so as to avoid increasing the back pressure, while at the same time the heat of the exhaust steam should be imparted thoroughly to the water. Of course, the consideration of strength and convenience of examination, and putting the tubes in place and packing their ends, should not be neglected. This makes a good heater, but it is an expensive one. Coils of pipes, with plain cast-iron heads at each end of shell, may answer your purpose.

(108) T. J., Worcester, Mass., asks: How can I find the logarithm of a number without the use of a table? Or, in other words, how are tables of logarithms computed? *A.*—For a table of Napierian logarithms it is only necessary to compute the logarithms of prime numbers, those of other numbers may be found by taking the sum of the logarithms of their factors. Let the Napierian logarithm of a number be designated by the symbol l. The logarithms of numbers are found as follows:

$l\,1 = 0,$

$$l\,2 = 2\left(\tfrac{1}{1} + \frac{1}{3\times 3^3} + \frac{1}{5\times 3^5} + \frac{1}{7\times 3^7}\cdots\right) = 0.693147,$$

$$l\,3 = 0.693147 + 2\left(\tfrac{1}{1} + \frac{1}{3\times 5^3} + \frac{1}{5+5^5} + \frac{1}{7\times 5^7}\cdots\right) = 1.098612,$$

$$l\,4 = 2\times l\,2 \quad \ldots\ldots = 1.386294,$$

$$l\,5 = 1.386294 + 2\left(\tfrac{1}{5} + \frac{1}{3\times 9^3} + \frac{1}{5\times 9^5} + \frac{1}{7\times 9^7}\cdots\right) = 1.609437.$$

In a similar way the logarithms of other numbers are computed. The common logarithms, or the Briggs' system, are found by dividing the Napierian logarithms by 2.302585. You will find this whole subject thoroughly explained in Davies' "New Bourdon." The foregoing shows the amount of labor involved in computing the logarithm of a number, and the impracticability of working without a table of logarithms.

(109) N. L. H., Syracuse, N. Y., writes: Please explain in full the method of setting Corliss valves. *A.*—"Take off the back bonnets from cylinder, and notice that the lines marked on the valves and on the cylinder are the lines of opening. On the back of hub of wrist-plate will be found a center line, and a line will also be found on the corresponding hub of stand which supports the wrist plate; when these two lines meet, the wrist plate will be in its midway or central position. On either side of center line of wrist plate stand will be found another line, which marks the vibration of wrist plate, and when center line of wrist plate coincides with either of these lines it will be in its extreme position. Place the wrist plate in its central position, and, by means of the adjusting nuts, make the lengths of the valve connections such that each steam valve may have the proper amount of lap—say, from $\frac{1}{8}$ inch in a small engine to $\frac{3}{8}$ inch in a large one—and that the exhaust valves may be just ready to open, or without any lap. Then connect the eccentric hook to its pin on the wrist plate, and turn the eccentric around loose on the shaft, and, if necessary, adjust the length of the eccentric rod so that the center mark on the wrist plate will vibrate to the lines of extreme travel marked on the stand. Then place the crank on either dead center, and turn the eccentric on the shaft, in the direction in which the engine is to run, enough more than one-quarter of a revolution ahead of the crank to show an opening or lead of the steam valve nearest the piston of from $\frac{1}{32}$ to $\frac{1}{8}$ of an inch. Then tighten the set-screw in the eccentric, and turn the shaft with eccentric one half revolution in the same direction, and notice if the opening or lead is the same as on the other steam valve; if not, adjust it by making its connection either longer or shorter as may appear necessary. To adjust the cams for disengaging the steam valve hooks, let the governor balls remain in their lowest position, and move the wrist plate to either extreme of its travel and hold it in this position; then lengthen or shorten the cam rod for the steam valve at opposite end (which will then be wide open), so that the steel cam on the brass cam collar will touch the curved arm of the cut off hook; move the wrist plate to the other extreme of its travel, and adjust the other cam rod in the same manner. To prove the correctness of the cut off adjustment, raise the balls of the governor to about where they would be when at work, or to a medium height, and block them there. Then, with the eccentric connected to wrist plate, turn the engine shaft slowly in the direction in which it is to run, and, when the cut-off hook is detached by the cam, measure upon the slide the distance the crosshead has moved from its extreme position. Continue to turn the shaft in the same direction, and, when the other cut-off hook is disengaged by its cam, measure the distance the crosshead has moved from this extreme position, and, if the cut off is equalized, these two distances will be the same. If they are not, adjust the length of the cam rods until the points of cut off measure alike. Wherever convenient, it is desirable that an indicator be applied to the engine when at work, and this setting of the valves tested and more accurately adjusted, so that the engine may be in the best possible condition for economical work." The above relates to Corliss engines built by the Fishkill Landing Machine Company.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gears, Lex'n, Mass., & Phila., Pa. See p. 12.

Forming Lathes Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith M. T. Co., Mill., Wis.

Turret Drills, 6 spindles. A. D. Quint, Hartford, Ct.

Chucks, the Nat'l, est'd 1882. 39 Cortlandt St., N. Y.

Speed Gage McLauthlin & Co., Fulton St., Boston.

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Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

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Engine Castings, Humphrey's Foundry, Bellefontaine, O.

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Steam Pressure Regulators, Reducing Valves, Safety Checks. Foster Engineer'g Co., Newark, N. J.

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"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Second Monthly Meeting of Mechanical Engineers—Discussion of Professor Sweet's Paper (Abridged.)

(Continued from last week.)

DR. CHARLES E. EMERY: I wish to express the great pleasure that I had in listening to the greater part of Professor Sweet's paper. Coming from an engine builder it showed research, great thought and, above everything, great liberality. There is a place for the work of everybody. I am sure that the paper we have heard enables us still more to appreciate the very just and high character of its author.

In regard to details I was about to raise the same question that Mr. Kent did in regard to the German engine. It certainly was next except as to the matter of casting, something in a small air engine that Professor Sweet was kind enough to call my attention to, the best finished work there, and it was a very creditable piece of work. It, however, ran only 100 revolutions a minute, if I recollect rightly. Compare that with the work done, for instance, by the engines of the "Paris" and "New York." The speeds are about the same. There is a little less, of course, on those large engines of 10,000 horse-power. They are only calculated to run a little over 80, but I have stood between the cranks when they were racing 85 and 90 and running perfectly smooth, and they working up to their full capacity. That shows what a marine engine can do, and it puts this engine in its proper light. It is simply a good torpedo boat engine running well and creditably, and the most prominent feature in it, to my mind, was that they were using an American cut-off. They had the Rider cut off valve in order to get regulation. That engine was not the most creditable engine there, in my mind. By going off into a corner of the grounds there, into the station of the Intramural Railroad, you would find a 170 kilowatt generator run by the Williams engine, a unique engine all the way through. It was of the marine engine type, but it was handling a generator very much heavier than the old fashioned engine, and it would stand right up to its work, running 2,500 amperes, 560 volts there, slowing up when necessary, because it was not large enough to carry it, and then rising up to speed again. It ran the road without assistance from any other engine. It was a very creditable performance, and those who did not happen to see it missed something.

There was so much in the details of the various exhibits there that I cannot go over them in order. I was particularly impressed with the large number of engines with single valves, regulated by the governor, compounds and single engines, all working well. That feature has been commented on already. Now, that is an improvement of which we, as Americans, should be proud. The high-speed engines had their troubles at first, and they were largely due to bad work. They were due to bad governing, and between the two there were considerable breakdowns, and there were hot bearings, and they were not popular. But those engines worked well, and a great many of them were fully loaded, and it was one of the pleasant sights of the Fair to watch them running so quietly, and with so little apparent effort. Of course, the magnificent monuments, the larger engines, were attractive in their way. It was a misfortune that on one of them, made a special engine for the Fair, it was attempted to put a new valve gear, and they did not make it work. But, after all, it should be simply called a misfortune, because the man, for the first time probably, attempted to build a Corliss engine. He saw the necessity of some method of regulation with those very large engines. The lesson to be learned from the Schichau engine there using the Rider valve shows that they appreciate it as well abroad.

MR. ODELL: In regard to the Corliss engine at the Centennial it probably was not of the best design, and it has been a subject of ridicule. But about that time, from 1872 to 1876, it was my good fortune to be very intimately acquainted with George H. Corliss. I did a great deal of testing for him, and those who knew Corliss well, know that he always had some object in view in designing an engine. He designed that Corliss engine as an exhibition engine, and while he was building that engine he was designing an engine which has given about as good duty as anything from that day to this. I refer to the Pawtucket pumping engine. He was designing that engine at the very time he built the Corliss engine.

MR. KENT: The lesson of the engineering exhibit at Chicago to me was one of chaos. Steam engineering is undoubtedly undergoing a transition, and we do not know what it is going to eventuate in. There is a conflict between half a dozen types, and in each type there are half a dozen varieties. It looks as if in the next few years many of the engine builders of the country would be called on to revolutionize their shops and build a different kind of engine from what they are now building. We have heard encomiums of the high-speed small engine, running very high speeds and small powers. It looks as if the epitaph of that engine was very shortly to be written, because it has absolutely failed to demonstrate economy

of steam. The slow-speed engines of the Corliss type are likely to be driven out to a large extent by the marine type of engine, and it is a question whether that is the coming type. There have been a great many criticisms made of the marine type of engine, that is, the three cylinders, cranks at 120, vertical engine, on account of its supposed instability vertically; the vibrations, the difficulty of climbing upstairs to oil the engine and all these things. I would like some engineer who is acquainted with the subject to tell us whether there is really any serious objection to a vertical engine of that kind; whether the objection is sufficient to overcome the manifest advantages of small space, the possibility of connecting it to dynamos with the minimum possible space. The Westinghouse and the Willans exhibit also show that there may be a change in that direction, and the Willans exhibit certainly makes the automatic governor men a little alarmed by bringing back the possibilities of throttling governing again. Have we been making a mistake in saying that the throttling governor engine was a thing of the past? Shall we have to say that it is fully as automatic as the other when we put it on three cylinders? As I say, the whole thing is in a state of chaos, and we do not know where we are at.

Mr. Durfee: It may be of interest to the engineers present to know that prior to 1870 there were some Corliss vertical tandem engines designed by Mr. Griffin, and erected in the Phœnix Iron Works. Those engines are still running in those works, I believe. There was quite an interval of time between their erection and starting, through some change in the business, but the engines, I believe, have given good satisfaction from the time they were put to work until the present. In 1864 I put a Corliss vertical engine, 42x42, running 85 revolutions a minute, in the North Chicago Mill. That engine I subsequently took out and put into the Milwaukee Mill in 1868. . . .

Professor Hutton: What Mr. Kent says induces me to reminiscence and to confirmation of his feeling of uncertainty. In 1879, I was called on, as a sort of advisory engineer at Columbia College, to recommend to the Board of Trustees what form of engine we should put in to drive the ventilating fan of the building, which was then under construction. It was obvious that we wanted to have a high-speed engine, and Professor Trowbridge and myself acting jointly—Professor Trowbridge with his experience coming, of course, down from the Novelty Iron Works—agreed that the only engine that would meet the requirements of the case was the Porter-Allen engine, and there were several years during which all our class-room work was directed in that way. Mr. Porter could not furnish us with the engine when we wanted it, and the contractors went to the only other high-speed engine that there was in existence at that time, and that was the Buckeye. That was only three years after the Centennial—by the time it was put in it was four years—and at that time there were but two high-speed engines, and when Professor Sweet was asked to give the opening paper at the formation of the society, it was considered that it would be of great interest to have him describe to the American Society of Mechanical Engineers, just then formed, the special features of construction of his straight-line engine. That was a distinct novelty when this society was formed only fourteen years ago. When we consider that all this development of the modern engine, as we have seen it in Chicago, is the development of the last few years, we can appreciate how everlastingly rapid the development has been during that short time, and can concede that Mr. Kent's criticism is perhaps deserved that we do not know exactly what is the future and stable type of the steam engine.

I, personally, was very much struck with the remark made by Mr. George S. Strong at our meeting a month ago. Of course, Mr. Strong spoke as a locomotive engineer, but he made this point: Why in the world are the stationary engineers putting in power plants proceeding on a very extravagant basis which would strike a locomotive engineer as so very much beyond what is at all required? That there is no reason in the world why one boiler should not be able to furnish the 1,400 horse-power that the locomotive is continuously able to deliver, and that from that one boiler and two cylinders we should be able to get upwards of 1,000 horse power for perhaps very little over $12 000. There is no one who does not talk of an electric-light plant for $10,000, without at once thinking that means a good many boilers of the water-tube or other type, and a very expensive engine which in itself goes very near that sum of $10,000, and certainly we have every time a thousand horse-power plant is designed a figure that has much transcended the cost of a locomotive. If it be so, that the marine engine is a solution on land of the problem in that form, I think that there is a good deal for the engineer to learn in the direction of making a power plant of considerable magnitude for a little money.

Mr. Durfee: . . . There was one remark more that I intended to make in regard to the Corliss engine, and that was in respect to the excellent work turned out under Mr. Corliss' administration. When I took this 42 inch cylinder engine from Chicago to Milwaukee, I found that it was necessary to replace the dash-pots. They had got broken. I sent to Mr. Corliss for some castings, telling him that I would finish them at our works. To my surprise the dash pots came completly finished. Even the bolt holes, two-inch by two and a half, reamed bolts, were bored. The lugs for bolting them on to the frame were all planed off. I put some men to work on Sunday to put those dash pots in position, and, to my surprise, when we got the stems of the dash pots where they belonged, the planed face of this lug was in contact with the corresponding part on the face of the engine, and I drove those bolts through with a mallet myself, screwed them up, and that was all there was to do to it. It is more remarkable when we consider that that engine was the first engine that Mr. Corliss had made off of those patterns.

Mr. Forbes: Perhaps the public do not know what they want. But just now I have been at work on something I know very little about; that is engines, and it may help to answer Mr. Kent's question if I give my experience. There has been a procession of people up my stairs to look at that engine, and every one of them seemed to want a high-speed engine with just as few parts as they can possibly have. This little trap of a thing was nothing but a four-cylinder arrangement, single acting, and I believe that I could have taken at least 200 orders for a thing that I have not tried myself, in the last six weeks. Now the public may be mistaken. For instance, here in America, if we think of a washtub, we generally imagine it is a receptacle for water to wash clothes in. That is all right. But if you go to Europe you will see that instead of putting the water in the tub and washing in it, they do the washing outside. The public, I think, are inclined to want a simple engine of high speed, taking up just as little room as possible.

Mr Loring: . . . It is necessary, as you all know, either for land purposes or for sea purposes, to provide in boilers some method by which the ascending and the descending currents can be established and by which the steam can escape readily from the tubes. This ability to disengage the steam, at least is probably brought about by the vibrations of the locomotive upon the rails by which the bubble of steam is detached immediately it is made. There have been repeated efforts to apply the locomotive boiler to marine purposes with tubes far better arranged for circulation than they are ordinarily in the locomotive, and they have always been failures if they approximate at all the nature of the locomotive. With regard to the question put, I think there is no builder here who would dare to put the moderate quantity of bearing surface in the crank-pin that the locomotive carries. Whether it is the constant motion of the crank pin in the open air that keeps it cool or not, I am not prepared to say. But those proportions would not do for a steamer, nor would they do on land.

Mr. Holloway: . . . Mr. Chairman, we have the good fortune to have with us to night a gentleman from across the pond who for many years has been engaged in engineering in England, and who is a senior partner of a well known firm in England. There are in the room, I presume, some of those who had the supreme good fortune to go abroad a few years ago and to receive at the hands of their English brethren courtesies which made those of us who stayed at home very much regret that we were not with them. It is one of the pleasant things about engineering that in all parts of the world when engineers get together there is one common language that they understand, and when it comes to slide valves and cut-offs and compression and high steam and high speed and all that sort of thing, there is a universal language among engineers, no matter under what sky they were born, or in what country they may be at that time. I take it, Mr. Chairman, that our friend who is with us will be, perhaps, inclined to give us a little of his experience, and I will take great pleasure in introducing Mr. Platt, of the firm of Fielding & Platt.

Mr. Platt: Mr. Chairman and Gentlemen, I esteem it a great privilege to be here to-night. When I received the courteous letter of your secretary, I can assure you I was very much pleased at the prospects of meeting a number of American engineers. I have visited your country several times, and have had the good fortune to be able to call many of its engineers my friends, and I can assure you it always gives me very great pleasure to come over here, and much greater pleasure to meet American engineers in my own country. I do have that pleasure frequently, and I take great delight in doing what I can for them, because I owe very much to American engineers during my various visits. I may truly say that I have received the very greatest kindness and courtesy on every hand.

Referring to the subject of Professor Sweet's paper, I had not the opportunity of going to Chicago. I did expect and hoped to go, but my business would not permit, and, therefore, I had to get all the information I could from other sources.

Professor Sweet spoke of being at Battersea, at the exposition of the Royal Agricultural Society of England. Agricultural engineering owes very much to that society for the judicious way in which it has given prizes for excellence in agricultural engineering. Every few years they give prizes for certain branches, more particularly steam engines, and the engineers had such confidence in the experts employed by the society to conduct the trials that they devoted themselves very thoroughly to producing the best things they could, and the result was that they raised agricultural engineering to the very highest point of engineering science. That has fallen into disuse somewhat, and many of the large makers are resting on their laurels; but now and again they give prizes, and it brings to the front some of the younger engineers, and notably at the last competition it brought to the front many new men who have since reaped the advantage of those trials.

Professor Sweet referred to steam plowing. That is still carried on to a very considerable extent in our country. Parties get engines and let them out to hire, or rather plow the land at so much per acre for farmers, and considerable business is done in that way. I suppose you will come to that by and by in your country when you have exhausted your new territories in the West. Up to the present it has been very easy to work, I suppose, a virgin soil which does not require much cultivating. But by and by you will have to come to it, and then there will be work for engineers.

Referring to the Centennial engines built by Mr. Corliss, I had the pleasure of his acquaintance, and had some very pleasant meetings with him. They are a fine pair of engines, but I think Professor Sweet's criticisms were not unkind or unjust. I am rather surprised to hear of Mr. Jeers saying that he had not seen a finer pair of engines, because in Lancashire, up to forty years ago, all the large factory engines were beam engines and Hick Hargraves, before they took up the horizontal engines, did turn out a beam engine. Some of their nineties were really a magnificent type. When high piston speed came in the beam engine was doomed, and they took the horizontal engine.

One speaker referred to a type of engine that is used largely in England; that is, the under type. That was introduced some time ago by Roby & Co., of Lincoln, called a mining engine, because it was produced for operating winding drums for sinking collieries or for working small collieries, and it proved a great success, and other makers took up that type of engine. It is practically a locomotive form of engine without wheels.

Some one has referred to the locomotive boiler not being more generally used in stationary work. Well, some of you know that Mr. E. D. Leavitt used the locomotive type of boiler very much for some of his work. But you will bear in mind that it is usually continuous work. That is, they work day and night, and that is one great advantage in locomotive boilers, to keep the boiler always in work. That is the difference between the American and the English locomotives. You can use steel fire-box plates in America, and we cannot use them in England, because you run your locomotives day and night with two sets of men, and ours are only run days. They go into sheds at night and cool down, and, I think, that is one great reason why steel boxes won't stand with us, and another reason is that our boilers are more rigid. They are stronger and better stayed, and not so elastic as the American build of boiler.

Referring to high speed engines, some of us know that many high-speed engines come into the market and they disappear again. I recollect some 12 years ago Mr. Coleman Sellers asked my opinion about a high speed engine. I said it is a very nice engine. It does very well if it has not much to do and has not to do it very often. (Laughter.) That was my opinion of that engine, and I think he found it was about true. But, certainly, the Willans engine has had the most phenomenal success. It has been very much used in England and is doing very good work.

Some one remarked as to using the marine type of engine more extensively for land purposes. There has been a tendency in that direction in England. Many large factory engines have been erected of that type, some of them running very considerable piston speeds, but they do not run so comfortably as the horizontal engines of longer strokes. There is a good deal of trouble with the packing boxes. The grit and dirt work down into the gland, and that I believe is the principal trouble they find in England. Hick-Hargraves have erected some very fine examples, but still they stick more generally to their horizontal compound type, and are making some of very large powers.

I see a very great development in American engineering as I come over every few years—very wonderful strides, and this time I can see a very marked improvement in style and strength and capacity of your engines. I have been over the war-ship plants and I am sure they are a credit to any country. I had the pleasure of going over the "Columbia," which certainly is a marvelous collection of pistons, cylinder valves, and what not. It is really a wonderful collection of machinery.

I must not trespass more on your time. I have very great pleasure in meeting you here and I hope I may see some of you in England.

There is one more remark I would like to

make. The Centennial engine I saw in Belgium, made by Vanderkirk, exactly similar to the Centennial engine, made from the same drawings and exactly the same form.

Dr. Emery: The remarks of Professor Hutton make it appear to me very proper to mention the originator of the high-speed engine with a single valve. I refer to our late lamented associate, John C. Hoadley. I think any one who will go over the facts will realize that such is the case. We had the hog motion, as it was called, the sliding of the eccentric across the shaft, long before his time, and it was, therefore, known that that was applicable. But the first instance that I recollect of an engine that worked properly, that was the prototype of the present high-speed engine, was exhibited by John C Hoadley at the Centennial Exposition. He was building a line of portable engines with locomotive boilers, and the engine of that type mounted upon it. He had there the present modern spring governor, well proportioned to give good regulation, and he had the piston valve, and in a test of that engine it ran down to 26 pounds to the horse-power, high pressure, non-condensing, or below the tests I have made of engines developing the same power of the Corliss type. That was in 1876.

Mr. Odell has stated here that Mr. Corliss at the same time he was building the Centennial engines was also building the Pawtucket engine. I was there when the Pawtucket engine was on the floor, and I found that they had been very closely studying the experiments made by Mr. Loring and myself. To that extent they had seen what was in the wind.

Again, Mr. Durfee has spoken of the engines at Phœnixville. Those who visited the civil engineers' rooms during the Centennial would have seen there the original and complete drawings of those engines. The original drawings for Mr. Griffin were made under my direction. Mr. Griffin knew what was wanted in a rolling mill. He said he wanted a good compound engine designed that would regulate on their work. He wanted a cast iron shaft so many inches in diameter. Those were the instructions that were given. The engines were finally contracted to the Scott Iron Works. The Scott Iron Works persuaded him to allow them to put on the Corliss gear. The sizes of cylinders were as originally designed. The regulation was secured simply by making the large cylinder much larger than had been customary, so that in following full stroke through, there would be power enough to start the rolls up to speed, and, as has been said, those engines have run successfully until the present time.

Mr. Platt: . . . Mr. Kent spoke of the small engines. I saw the Delavar steel turbine there and studied it considerably, and from what I saw and from the information given me by Professor Reuleaux, who has made tests of one of those turbines in Berlin and has been making those tests, I believe, for many months, the steam economy is coming down to very much lower proportions than anywhere else. I do know that Delavar at present is constructing an engine in Sweden of 5 000 horse-power to run as a turbine which they expect will surprize the engineering world. His plan always has been to follow out that work even for years before saying anything about it.

We have just heard of over fitting. I do not know whether it is over-fitting or what that we have to look to. But, certainly, I was surprised at the number of hot bearings and breakdowns that took place at the Chicago Exposition. From the first right through to the end we were constantly seeing engines of one kind and another stopped—bearings hot, cylinder heads blown out, and one thing and another was constantly going on. It was something that ought not to have been seen in an Exposition of that kind. Just where the reason is I do not know. But I must say this was a great surprise to me. Referring to large vertical engines, Hick-Hargraves has been spoken of. I was in their place in England a year or two ago and they had then six or seven large engines, up to two or three thousand horse-power, vertical. I noticed that they paid great attention to the crank-shaft bearings. They were all made a big swivel bearing. They used also a great deal of steel in the framing. But I know that they considered that a good deal of trouble had taken place in those big engines with the crank shaft and crank-shaft bearing, and they had designed this bearing to get over the difficulty. They seemed to have great success with the engine, and I know of building a number of them for electric lighting purposes.

We were speaking of the questions of bearings heating, and the question of end play. Now the firms in the North there always allow one eighth of an inch—and even more than that—end play in the main bearing and the crank shaft bearings too, and they never get hot and they wear forever. I know engines that have been put up inside of two or three days at a big mill and started up, and then they will go on working and perhaps will be six months before the engine stops.

Mr. Binsse: In regard to old engines I am rather surprised that no one has referred to an engine that was shown in 1876, the first engine which was ever put to work in this country, a pumping engine which was at the Schuyler copper mines at Arlington, and parts of which exist, I think, at this day, and were until very recently to be seen at Newark. It is rather an interesting fact that the person who came over to drive it was Mr. Hornblower, of whom Chancellor Hornblower, of New Jersey, and Mr. William B. Hornblower, are the direct descendants. I believe Mr. Hornblower must be a relative of the Hornblower who had a patent suit with Mr. Watt at that time.

Mr. Forney: I have listened to the discussion this evening with a great deal of interest, and it happens to me, as it happens to most other people, that I am very apt to look at subjects through the spectacles I am in the habit of wearing. For a good many years I have been in the habit of looking at steam engines only as they are applied to locomotive purposes. There has been a good deal said this evening about the defects and the deficiencies of stationary engines, which somehow seemed to me to have been solved to a considerable extent in locomotive engines. We have heard this evening about the high-speed engine, which was introduced, I believe, in the first place at the Centennial. It seems to me if we refer to locomotive practice we will find that high-speed engines were used as locomotives a great while before the Centennial exposition. I think we might go back even to the time of the Rocket and find that that was a high-speed engine. So that as far as the problem of high speed is concerned it strikes me that it was solved in locomotive practice a long while before the Centennial exposition.

Now, there are a good many other problems which come up to locomotive men. It is not only a question of high speed, but it is also a question of slow speed. Such engines must be built to work at the very slowest speed at the maximum capacity that it is possible for them to exert and then gradually increase the rate of work and the amount of power developed until you reach speeds of sixty, seventy—some men are sanguine enough to say eighty miles an hour. Such conditions are very different from the conditions under which a stationary engine, or even an ordinary marine engine, must work. The power developed in a locomotive boiler differs immensely from that developed in a stationary or marine boiler. Some experiments made on the Baltimore & Ohio Railroad, on the heavy grade over the Allegheny Mountains, showed that they burned 196 pounds of coal per square foot of grate per hour. As there are about 20 square feet of grate on an ordinary locomotive boiler, that means they burnt about 4,000 pounds of coal per hour, and as they would evaporate about 6 pounds of water, it is not a difficult matter to get at the amount of work done by that locomotive in that period. Some tests show that they have burned over 200 pounds of coal per square foot of grate per hour. I think it would be very difficult to find any marine engine or any locomotive engine boiler which does any corresponding amount of work.

Commodore Loring this evening has told us that no one would dare to place a locomotive boiler either in a ship or in a stationary engine, and expect it to do the great amount of work done in locomotive practice, and apparently he attributed that difference in the operation of the locomotive boiler to the fact that it is working under a certain amount of tremor during the whole period of its active exertion. It seems to me that if that is the fact, if the difference in the working of a locomotive is attributable to that fact, it would be a wise thing to apply a sort of Swedish movement cure to a locomotive boiler, and keep it in a constant state of tremor while at work. (Laughter.) The secret of that, it strikes me, must be somewhere else. At any rate, it is worthy of very careful investigation to see how much the superior efficiency of locomotive boilers is due to that tremor or the roughness of the track.

You have also, no doubt, heard a great deal about the difficulty they are having in the English Navy in keeping tubes tight. I have asked the question a good many times as to whether in marine boilers they use copper ferrules on the ends of their tubes, and I find that practice is not at all general. In locomotive practice it is almost universal now to fit the fire-box end of the tubes with a copper ferrule on the outside of the tube between it and the tube sheet, and then calk it up over that. I think no locomotive man who understands his business would dare to put steel or iron tubes into a locomotive without putting in a copper ferrule. I think that is a matter worthy of imitation in some of the marine or perhaps stationary practice.

Furthermore, we have heard that locomotive crank pins are made of such a size that no one would dare to imitate that practice in a marine or stationary engine, and that fact is attributed to the circumstance that the locomotive crank pin is revolving at a very high rate of speed in the open air, and is thus cooled down in the current of air to which it is exposed. If that is true it strikes me as a very simple expedient to put on a blower and blow onto the crank-pins, and keep them cool. (Laughter.) Another gentleman has spoken of the difficulty of keeping the shafts of marine engines in a state of integrity. We find the locomotives running at these high rates of speed over tracks of every degree of roughness and of smoothness, running by day and by night, in the cold and in the heat, and still our shafts are not constantly breaking. Then another gentleman has said this evening that a great deal of difficulty arises from the fact that we have too much good fitting; that our engines are built too well; that we do not allow end play. Now, those bad things seem to exist in locomotive practice. If we do not allow end play, the working of the locomotive very soon provides it for itself, and our great trouble is to keep them from having end play. It, therefore, would be perhaps advisable to shake up ordinary stationary engines and marine engines so that they would give more of this end play that is so desirable.

I think there are a good many things worked out in locomotive practice which it might be well to look into, and find out just what the principles are which enable us to do things in locomotive work which cannot be done in stationary and in marine work.

Mr. Darling: The question has been asked what is the engine coming to? What is going to be the ultimate type of engine? It seems to me that there is a place for everything, but everything must be in its place. I think that the place for a marine engine is on board a ship and not in an electric lighting station, and that engines that carry a load one minute of 500 horse-power and the next minute of 2 horse power should be built to stand the strain. . .

The Chairman: Before we close I wish to announce that the subject of the next meeting will be "Testing Machines and Tests of Materials," and that an introductory address will be given by Mr. J. Sellers Bancroft, of William Sellers & Co., of Philadelphia, describing the recent improvement in the Emery system of testing machines. I will also announce that we have a model of the Buckeye valve gear here; also some interesting examples of protection of iron by electric deposition of a salt of lead.

Mr M. D. Woods: I would like to say a few words in regard to the remarks made this evening, principally by Mr. Kent, respecting the future type of engine. I cite the Corliss engine as being possibly the most remarkable engine in its day that ever was developed. We have not got to go far from our homes to find a Corliss engine running, 42 inch stroke, 165 revolutions a minute, under 75 and 85 pounds of steam on the continuous rod mill of Cooper, Hewitt & Co, at Trenton. That engine, to my knowledge, has been doing its work from 6 to 8 years with a very low percentage of repairs. Being in that mill daily for six months I never saw the mill shut down for the repairs of the engine. . .

Another fire at the World's Fair buildings since our last issue—said to be of incendiary origin—suggests the opinion that it would have been fortunate if all the buildings had been emptied and burned by special enactment, or something of the sort, at the close of the Exhibition.

A furnaceman named De Freese, in the employ of the Ramapo (N. J.) Iron Works while about to drop the bottom of a furnace remained under it a little too long, the result being that he was very severely burned. This all goes with the trade

MANUFACTURES.

Platteville, Wis., is agitating the putting in of water-works.

The Rogers Locomotive Works, Paterson, N. J., have resumed, after an idleness of more than two months.

The appliances for heating and ventilation at the hospital for the insane at Spencer, W. Va., were furnished by the Buffalo Forge Co., Buffalo, N. Y.

At Rockaway, N. H., the Liberty Bicycle Works, which closed down last July, have again started, taking on 150 men, and are increasing the number daily.

The Campbell Printing Press and Mfg. Co. are about to remove the mechanical portion of their business from Taunton, Mass., to their new works in Brooklyn, N. Y.

The Standard Turning Works, Cambridgeport, Mass., is a concern that furnishes handles and all forms turned in any kind of wood, or formed in any way. A little box of samples the company sends out gives a good idea of their work.

The Penberthy Injector Co., Detroit, Mich., have put on the market a silver paste which, it is claimed, gives an almost instantaneous silver plate to brass goods It will cost an engineer ten cents for a sample box to find out what it will do.

The large plant of the Chattanooga (Tenn.) Tool Company, which has been idle more than three years, has been purchased by a stock company, headed by George B. Durell, and will be put into operation at once with a large force of men.

The Heine Safety Boiler Co., St Louis, Mo., issue a very neat trade catalogue, illustrating and describing the construction of the Heine boiler as well as some of the steam making plants in which it is employed. The New York office is 136 Liberty street.

It has been given out by Superintendent Ripley, of the Lake Side Nail Company, Hammond, Ind., that the great plant there, which has been closed down since last December, would start up full blast early next week, providing the men would sign the new scale.

The iron roof over the dye house for George C. Hetzel & Co., at Chester, Pa., will be furnished by the Berlin Iron Bridge Co., of East Berlin, Conn. This company is also building the roof for the new electric light station for the Citizens Electric Light and Power Co., of Lancaster, Pa.

Norton Bros., Chicago, Ill., whose city can factory was burned out on January 20th, inform us that they were fully insured, and will rebuild at once. In addition to the power plant required, this will make an immediate market for a large amount of machinery such as is used in the manufacture and decoration of sheet-metal goods.

The large woolen-mills of Howland Croft, Sons & Co., Camden, N. J., which closed down a few weeks ago, have resumed work with 200 hands. It is expected that by the middle of March 500 workmen will be employed in the mills.

The large factory of the J. I. Case Threshing Machine Company, Racine, Wis., which has been closed for the last five months, depriving 600 men, nearly all of them heads of families, of employment, has started up with a full force. Enough orders have been received to keep the works in operation for several months.

The Brady's Bend Iron Works property near Kittanning, Pa., was sold February 6th at trustees' sale to New York capitalists for $80,000. It consists of 600 acres; all that remains of the old Great Western mill is the brick smokestack. The company was caught in the panic of 1873. The purchasers propose to develop the property.

William Sellers & Co. (Incorporated), Philadelphia, Pa., issue a catalogue of hydraulic testing machines, made on the system of C. E. Emery. The Emery machine has gone away to the front in the line of testing machines, and the catalogue will be of interest as showing what is being done with these machines in the way of putting them into every-day use.

The Knowles Steam Pump Works, 93 Liberty street, New York, has issued a special catalogue more partfcularly relating to pumps for paper-mill works. As is well known, there are special features pertaining to pumps as ordinarily used in paper-mills; hence this catalogue will be of special interest to paper manufacturers and to mechanics employed in paper-mills.

This shows an opportunity for business abroad in the direction of American hammers. Hammer makers may do well to send catalogues: "In our work-houses we feel the loss of a hammer which is put in motion by the transmission wheels, and we would be very much obliged to you if you would indicate a manufacturer in the U. S. A., which makes such hammers and other iron-working machines. We shall consider ourselves greatly obliged by rendering your services. Waiting your further favors, we are, with esteem, Direction, Der Nesselsdorfer Wagenbau-Fabriks-Gesellschaft."

The two letters following are typical of many we are receiving, and which lead us to believe that the backbone of the business depression is broken: "Business is improving very nicely with us, and we are very sanguine that the worst is over, and that while we may not shortly expect any boom still we believe that the year will wind up very satisfactorily. We are, yours truly, Sebastian Lathe Co., Cincinnati, O., February 20, 1894."

"In reply to yours of 19th, we inclose you the contract for our advertisement for another year, and we are pleased to say we think it the best-paying advertisement we have, and while the outlay is very great we do not feel we can get on without it, and so decide to take it for another year. We are also pleased to say that we are now running our works full time since February 1st, and we have no doubt we will have business enough to keep us going in that way. We have not quite our old complement of men, but we hope to increase the number slowly from now on. The Hendey-Norton lathe is taking nicely, and, in spite of the hard times, we can sell them more readily than we can our cheaper lathe. We are having quite a nice export trade on them, and have established three agencies abroad to handle them. We inclose you a new advertisement, and send a wood-cut for same by express. This advertisement we would like to run, say, two weeks, and then come back to the Hendey-Norton lathe, and the traverse shaper for a couple of weeks, then pillar shapers. Hendey Machine Co., Torrington, Conn.

The Pond Machine Tool Company, of Plainfield, N. J., for whom Manning, Maxwell & Moore, 111-113 Liberty street, New York, are the sole sales agents, have just been awarded the contract by the Ordnance Department of the United States Army for the manufacture of gun lathes and other machine tools required in the construction of steel, breech-loading rifle cannon of 12" to 16" caliber. The order consists of three lathes for turning and boring guns—one lathe for turning and finishing these guns, one machine for threading and slotting the guns, and the rifling machine. This company have previously furnished to the Ordnance Department twenty three large gun lathes and two rifling machines for the manufacture of breech-loading rifled cannons of 8" to 12" caliber. The lathes for 16" guns are very much larger and heavier in every particular, as the finished weight of three of these lathes will be 460,000 pounds each. In the previous large contract awarded the Pond Machine Tool Company, the time for completing the contract was four years, and they finished the contract to the satisfaction of the Ordnance Department, all the lathes having been fully tested and accepted, nearly two years ahead of the time allowed them to complete the work. The lathes are to be built from designs by the Ordnance Department, and all the detail drawings and patterns will have to be made by the Pond Machine Tool Company. When the lathes are built they are to be erected at the Army Gun Factory, at Watervliet, West Troy, N. Y. They have eighteen months' time in which to complete the work. The amount of the contract is over $200,000.

Charles Churchill & Co., Limited, London, E. C., England, importers of American machinery, write us: "We have been much interested in reading the reports in the American Machinist from the manufacturers of the United States during the year 1893, and as our business is exclusively the sale of American machinery and tools in Great Britain and on the Continent, it may be interesting to you and your readers to know what progress has been made during the year in introducing the goods on this side of the Atlantic. It is pleasant to be able to give a very different report from those which you have published. We had every reason to be satisfied with the business of 1892, and the year 1893 opened up with very good demand, and continued steadily to increase to the close, so that our year's business showed an increase of nearly twenty per cent. We anticipated that the severe commercial crisis of last summer would reflect on this side, and that our sales would decrease, but, instead, we had the very best trade in the four closing months of the year, and the new year up to date shows a continuation of the same. We may mention as some of our sales here, 136 lathes, 127 drilling machines, 24 milling machines, 12 planers and shapers. In small tools, 1,800 chucks, 700 gross of hack saws, 1,075 breast and hand drills, 400 micrometers and verniers, with twist drills, calipers, rules, etc., too numerous to mention. On wood-working machines for foot and hand power, scroll and circular saws, etc., over 350. Disston's hand saws, over 300 dozen; Stanley planes, etc., 5,000; wood pulleys, 1,300. Leather belting, 22 000 feet, etc., etc. There has been a general complaint here of dull trade, and we can only account for our success by the fact that our introduction of high-class machinery and tools is being appreciated, and that manufacturers are realizing that the best tools are the cheapest. We are looking for a still larger increase during the current year."

Machinists' Supplies and Iron.

New York, February 24, 1894.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $13.00 to $14.00; No. 2, $12.50 to $13.25; Gray Forge, $11.75 to $12.50. Southern brands of good quality are obtainable at $13.00 to $14.00 for No. 1 Foundry; $11.75 to $12.50 for No. 2, and $10.75 to $11.25 for Gray Forge.

Antimony—The market is easy and quiet. We quote L. X., 9.30c. to 9.3/4c.; Cookson's, 10c. to 10 1/4c.; Hallett's, 8.80c. to 9c., and U. S. French Star, 10c.

Lard Oil—Prime is quoted at 66c. to 67c.

Copper—The market is dull. Lake Copper is quoted at 9 3/4c. to 9.80c. Casting Copper is held at 9 1/4c. to 9 3/8c.

Lead—The market is quiet, with sellers at about 3.23 1/4c.

Spelter—The market is dull. Offerings are more liberal at 3 80c. to 3.85c. for New York delivery, and it is intimated that less would be accepted.

Tin—Prices favor buyers, but there is no demand. Spot delivery is offered at 19.35c., and next month at 19.25c.

WANTED

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Wanted—Foremanship by one of exp.; engines, pumps, or gen. repairing. Indicator, Am. Mach.

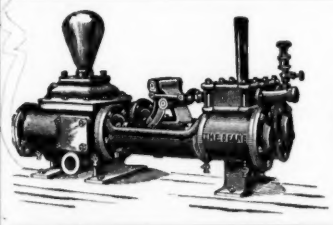
Wanted—Foreman in mach. screw m'f'y who possesses exp. in special work. Box 23, Am. Mach.

Mech. d'ftsman, tech. graduate, shop exp., wants employment; refs. Accurate, Box 29, Am. Mach.

Good dftsman and designer; graduate Polytechnic in Germany; experienced, wants position. Good references. Box 31, American Machinist.

Draftsman of varied experience, technical training, wishes position. E. L., 3413 Third Av., N. Y.

(*Continued on page* 13.)



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In Bars, Blocks, Sheets and Polished Rods,
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Bolt Cutters, Hand and Power Drilling Machines. Punching Presses, Tire Benders, Tire Upsetters and other Labor-saving Tools. Send for Price List.
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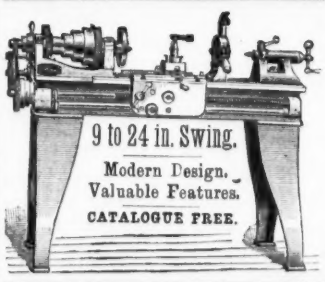

SOME LATHES ARE BORN CHEAP, (Because inferior.)
SOME ACHIEVE CHEAPNESS, (Ancient—out of date.)
SOME HAVE CHEAPNESS THRUST UPON THEM.
(Our case exactly.)
Because of the hard times we find it politic to cut prices to the very lowest notch, but don't think we neglect workmanship or finish; that we keep up to the highest point at all times.
On lathes, planers, shapers, drill presses, etc., we are making exceptionally low prices. Our catalogue will tell you all about our tools, prices quoted on application.
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BY
H. C. REAGAN, Locomotive Engineer.
145 Illustrations, 300 pages, 12mo, Cloth, $2.00.
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SMOKE STACK PAINT
Used on the ships of the U.S. Navy and by the prominent Steamboat and Transportation Companies. The only paint supplied in colors which has given absolute satisfaction where forced draught is used.
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Ready Made Cut Gears.
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Gear Book, 15 cents.
Treatise on Gears, $1.00.
Gear Cutting Machines.
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Lexington, Mass.,
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37, 51 and 62 Inch Swing, with Two Regular Heads.
42 INCH SWING, WITH TURRET HEAD, AND SCREW CUTTING ATTACHMENT.
All gears accurately cut. All feeds positive.
Machines are self-contained and therefore do not require an expensive foundation.
BRIDGEPORT MACHINE TOOL WORKS,
E. P. BULLARD, Prop. BRIDGEPORT, CONN.
New York Office, 39 CORTLANDT STREET, ROOM 86.

✻WANTED✻

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A 1st-class gen'l mach't wishes engagem't; shop, road work or as salesm'n. C. F. Alverson, Salem, O.

Situation wanted by first-class patternmaker. Address L., Box 432, AMERICAN MACHINIST.

Competent draftsman wants position. Marine engines preferred. Address Holmes, Ridgway, Pa.

Tool maker, exp'd, screw machine tools, cutters, punches, etc., wants position. Box 21, AM MACH.

Wanted—Situation by good, steady all-round molder as foreman, or 1st-class molder in small jobbing foundry. Good refs. Box X., AM. MACH

Wanted—A man who is thoroughly experienced in handling and operating gear and rack cutting machinery. Address Box 26. AM. MACHINIST.

Engagement desired by a practical engineer, competent to design all types of Corliss and high-speed engines and superintend the construction and erection of the same. Box 24, AM. MACHINIST.

Situation wanted by a practical draftsman and patternmaker, thoroughly acquainted with Corliss and high-speed engines; competent to take charge. Address Box 25, AMERICAN MACHINIST.

Foreman of boiler shop, A No 1 layer out and manager, wishes to change employers; will turn out work on contract if desired. Expert, AM. MACHINIST.

Situation wanted by first-class tool maker; 18 years' experience in tool-room of large works, including model and experimental; could take charge; first-class reference. Box 30, AM. MACH.

Wanted—Foreman for erecting and machine shop by a pump company manufacturing steam pumps. A good opening for a young man of energy and experience. State age, experience, and references. Address B., AMERICAN MACHINIST.

Wanted—One good practical molder, one who understands thoroughly both green and dry sand molding; there will be a steady job and good pay to a man that is a good mechanic and industrious. Address stating age, experience, character, and wages expected to "Foundry," AM. MACHINIST.

Wanted—Situation by expert all-round machinist as foreman, assistant, or responsible position as first-class machinist. Exp'd on engines, general and special machine work. Developing inventions, designing jigs, etc., for expediting and duplicating work. John T. Usher, Box 22, AM. MACHINIST.

Open for engagement by a man experienced for years past as machine shop foreman, assistant superintendent, superintendent and head draftsman on both heavy and light complicated work in steam, hydraulic and electrical machinery, steel and gray iron foundry and rolling machinery, wants position as plain every-day draftsman or anything else; don't hesitate to communicate even if you want only a subordinate. Address Box 28, AMERICAN MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S. M. York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa

For Sale—Second-hand drill presses, engine lathes & planers. Dietz. Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Calipers, Surface Gauges, etc. Catalogue free, Send for it. F A. Welles, Milwaukee, Wis.

Wanted—Patterns to make. Estimates made on application to Wattles Gas Eng. Co., Elizabeth, N. J.

Wanted—To buy lathes and planers, 24" and up. Box 27, AMERICAN MACHINIST.

For Sale—Supply business and machine shop in Central Pennsylvania. For particulars address P. O. Box 27, Harrisburg, Pa.

Wanted to arrange with some responsible manufacturing concern to put on the market a new gas engine which is entirely novel in gas engine practice. Box 13, AMERICAN MACHINIST.

Wanted—An Allen pneumatic riveting machine, such as is used for beam and bridge work. Second-hand machine preferred. Address The Castle Ice Machinery Co., Indianapolis, Ind.

Introduction and negotiation of American patents and machinery to English manufacturers and agents. Write for circular to Geo. Richards, M. I. M E., Mechanical and Consulting Engineer, No. 5 Laurence Pountney Hill, London, England.

Wanted—By a well-known English firm, a patented engineering specialty, to manufacture and sell in England and colonies. State full particulars to "N.", care T B. Browne's Advertising Agency, 353 -355 Canal Street, New York.

Bell Telephone.—Patent expired. Pair of reliable telephones, with full instructions for line, etc., $4 and $5. Magneto bells for use as call, $8 per pair; outfits for two stations, $14. Send stamp for circulars. C. L. Woolley, Manufacturer, 413 Robert St., Baltimore, Md.

Michigan Agricultural College offers instruction in mechanical engineering—four years' course; the average expense of attendance at the college is $135 per year; the course is arranged so as to give students an opportunity to earn a portion of their expenses. Address Mechanical Department, Agricultural College P. O., Mich.

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FOR TOOLS, DRILLS, DIES, &c.
ALL KINDS IN STOCK.
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Established a century ago.
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REDUCED PRICE OF LE COUNT'S
HEAVY STEEL DOG

This Dog has a Very Heavy Base, so that if the thread wears a Heavier Screw can be substituted.

No.	Inch.	Price.
1	3-8	$ .40
2	1-2	.50
3	5-8	.60
4	3-4	.60
5	7-8	.70
6	1	.70
7	1 1-8	.80
8	1 1-4	.80
9	1 3-8	.95
10	1 1-2	.95
11	1 3-4	1.10
12	2	1.20
13	2 1-4	1.35
14	2 1-2	1.45
15	3	1.60
16	3 1-2	1.80
17	4	2.10
18	4 1-2	2.75
19	5	3.25
Full set of 19		$21.60
20 (ext.)	5 1-2	4.00
21 (ext.)	6	5.00

When ordering, state as above, whether a full set or a set of 12, or small set of 8. Users of these dogs prefer them to any other make.

Le Count's Heavy Steel Dog. With Steel Screws, Lathe Made and Hardened.
One Small Set of 8—by 1-4 inches to 20 inch, - - - $6.25
One Set of 12—by 1-4 in. to 2 in. continued by 1-2 in. to 4 in. 13.25
These goods are for sale by CHAS. CHURCHILL & CO., L't'd, 21 Cross St., London, England.

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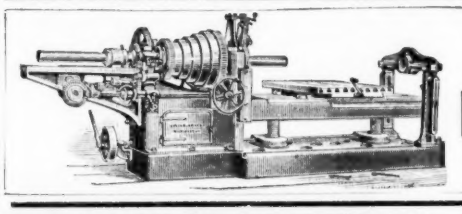
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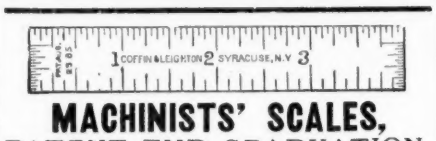

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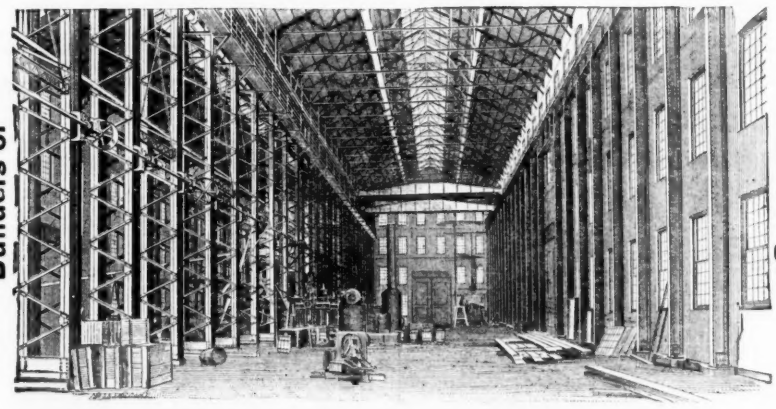
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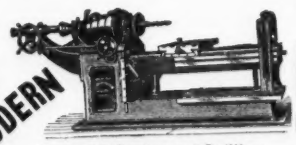
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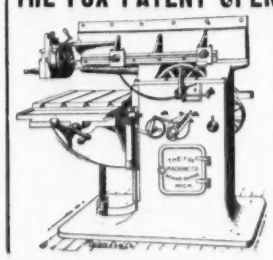
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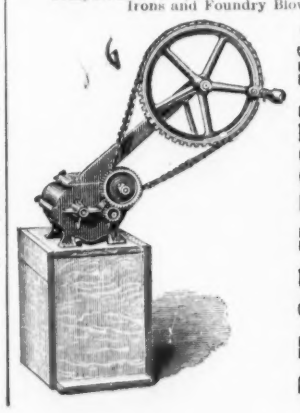
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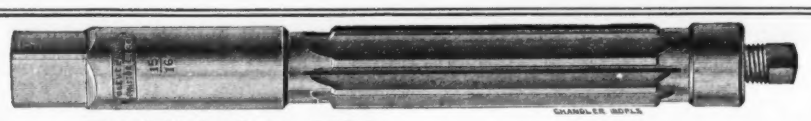

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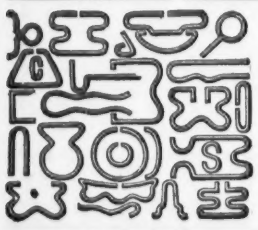

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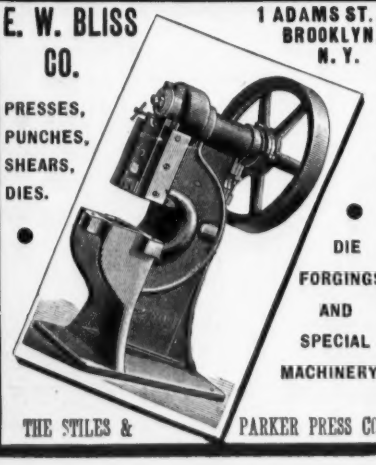

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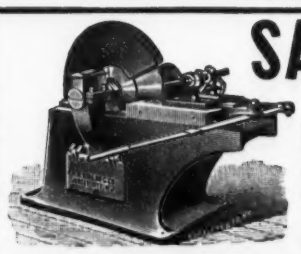

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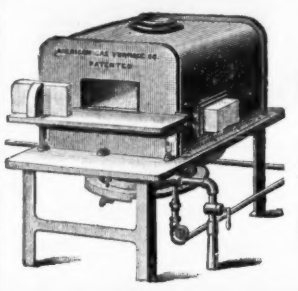

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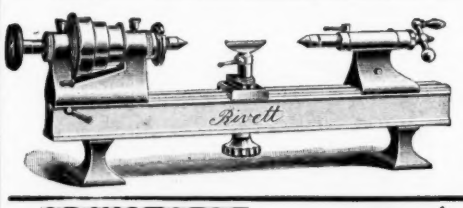

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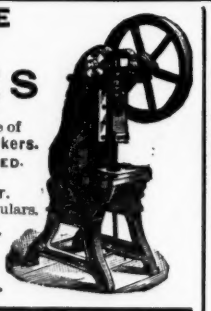

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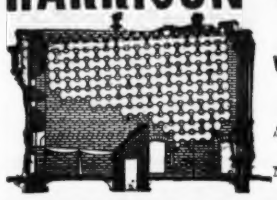

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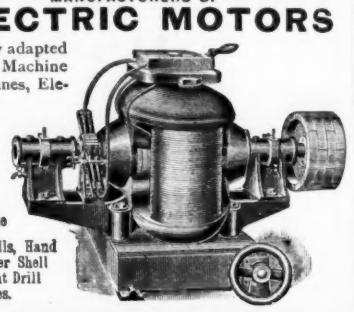

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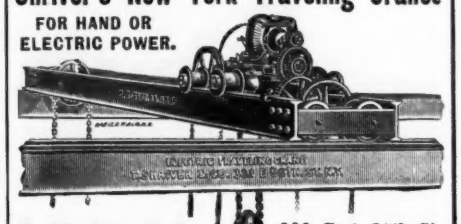

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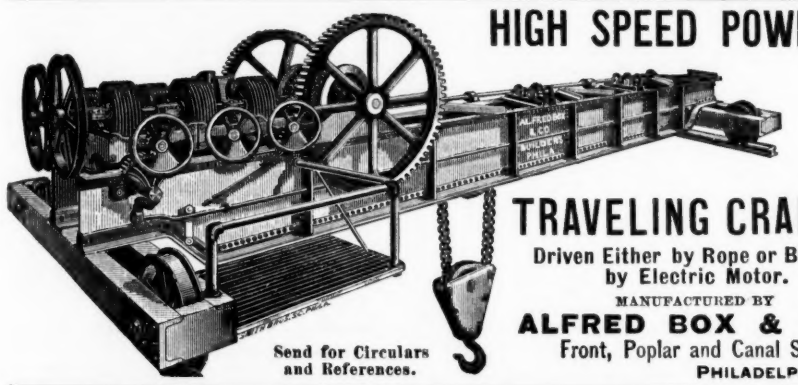

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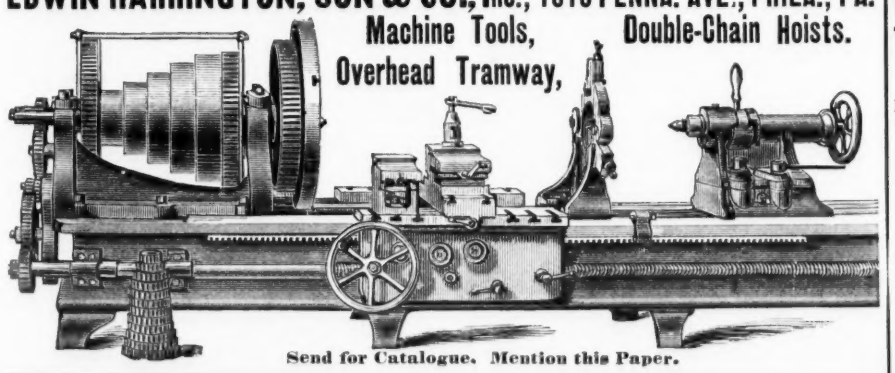

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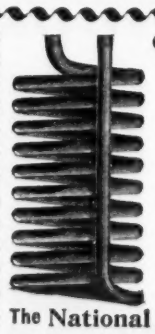

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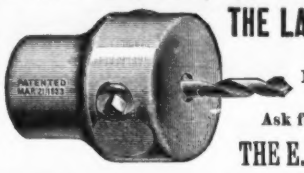

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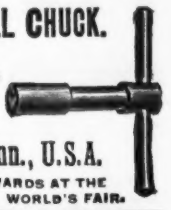

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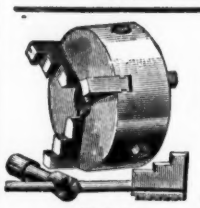

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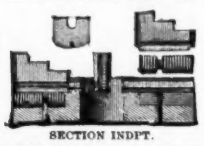

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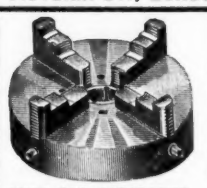

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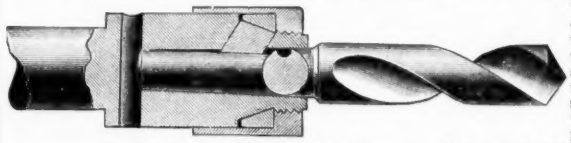

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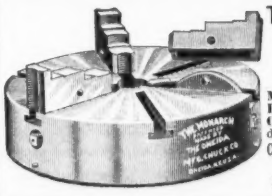

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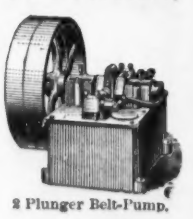

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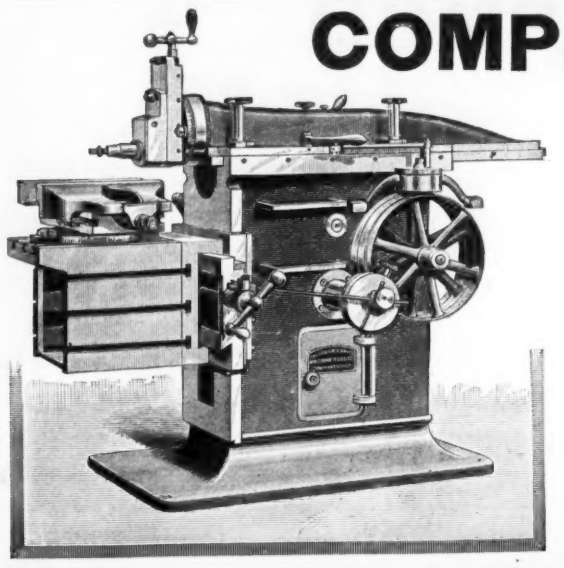

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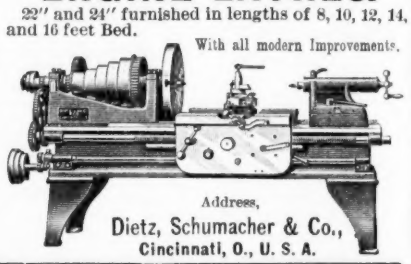

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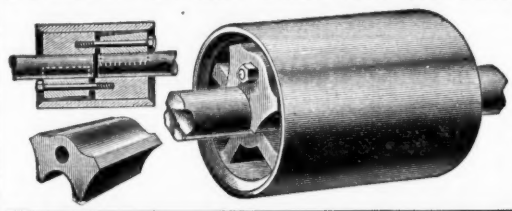

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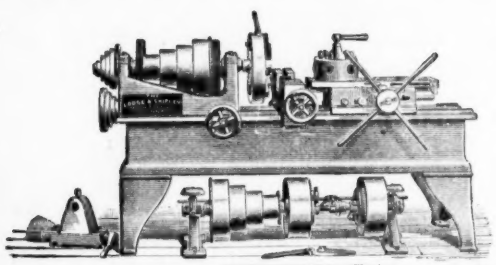

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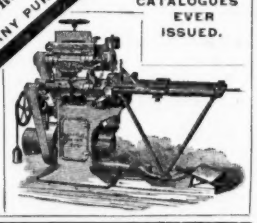

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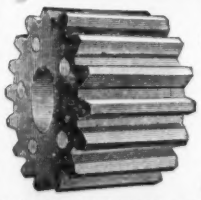

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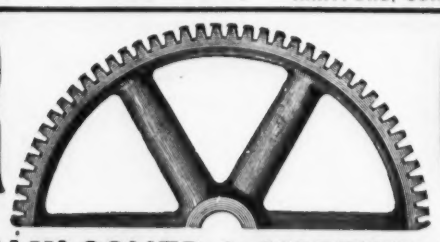

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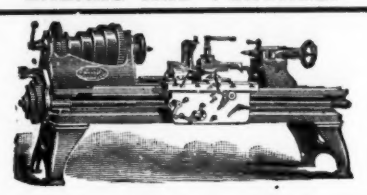

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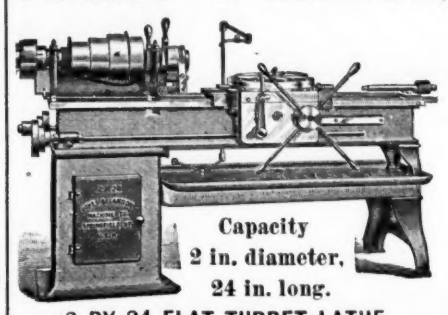

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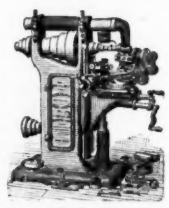

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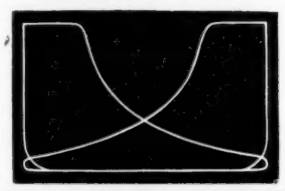

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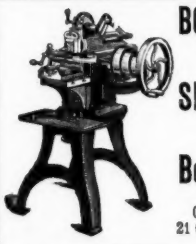

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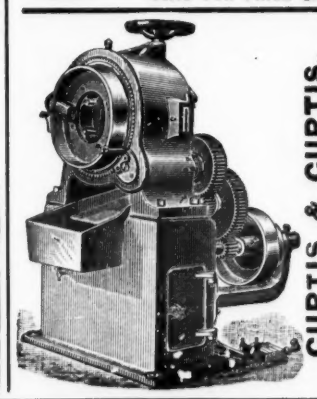

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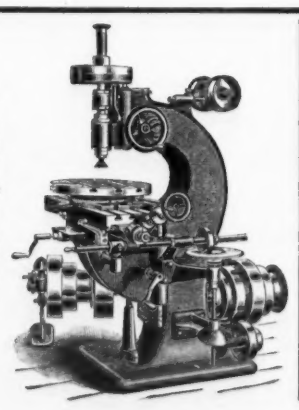

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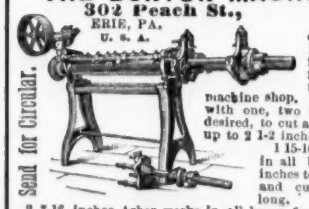

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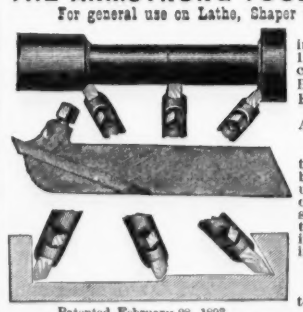

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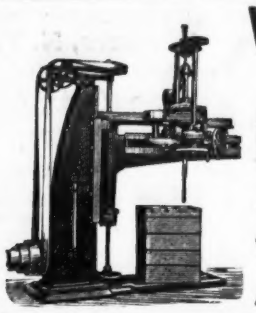

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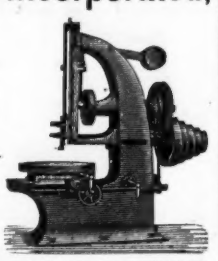

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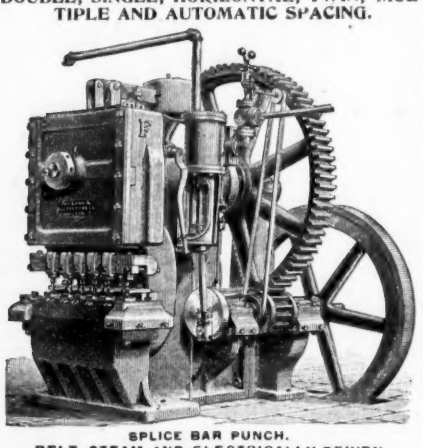

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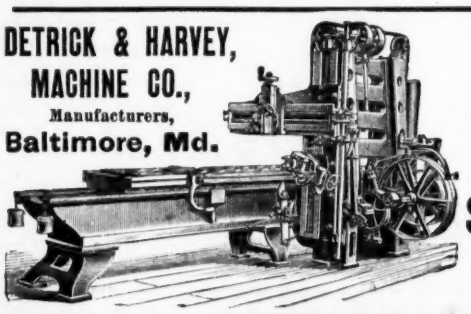

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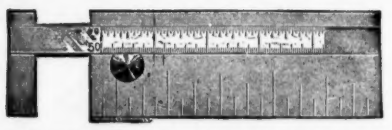

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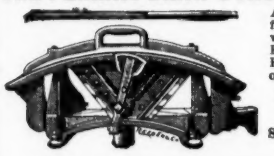

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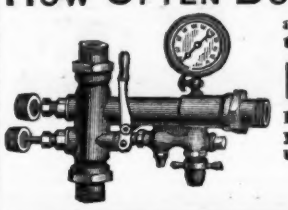

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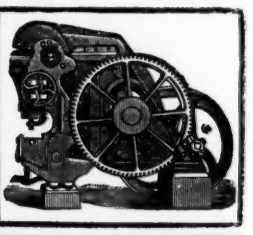

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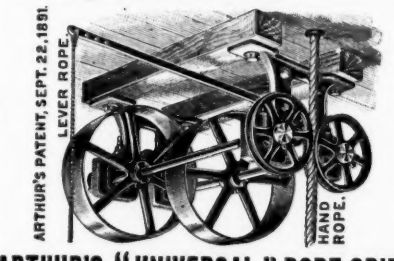

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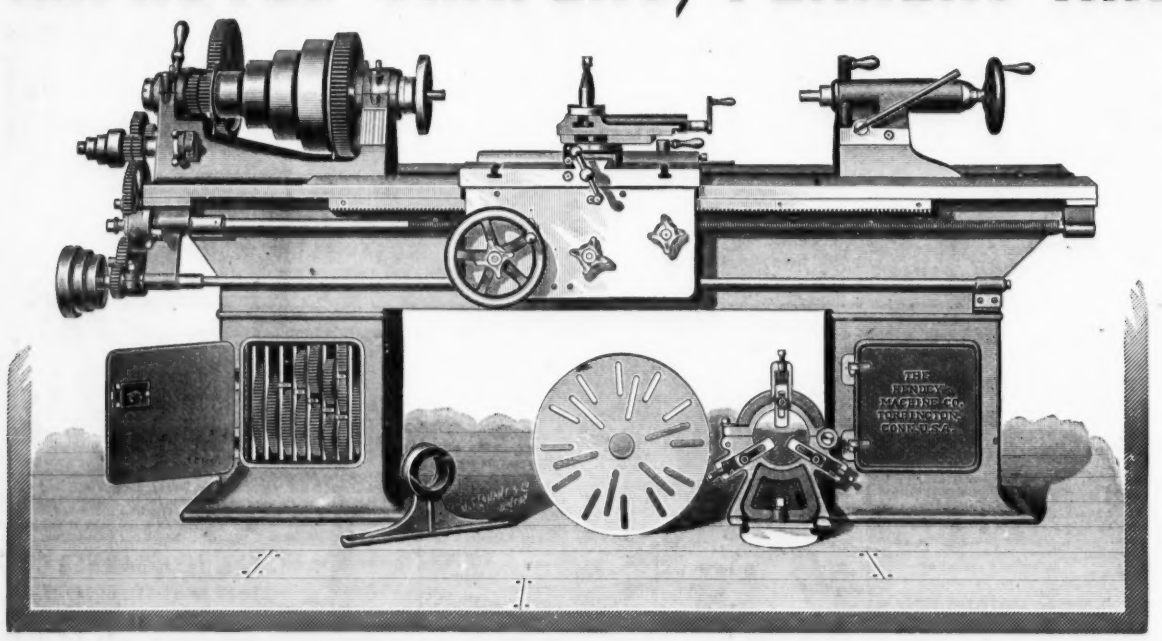

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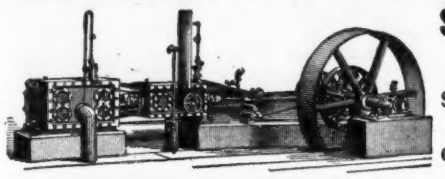

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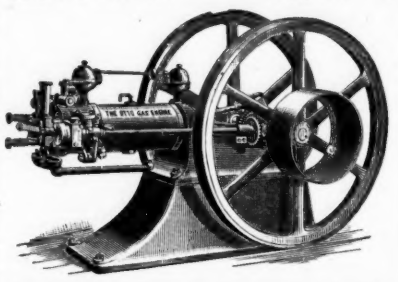

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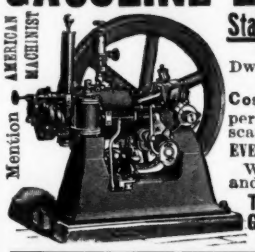

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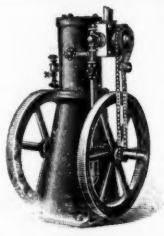

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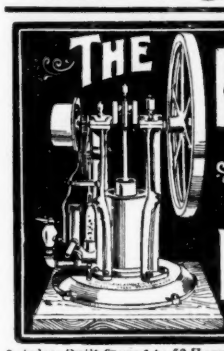

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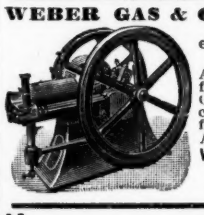

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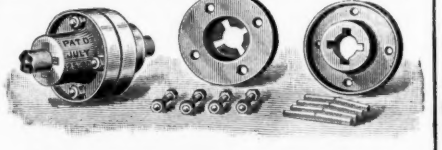

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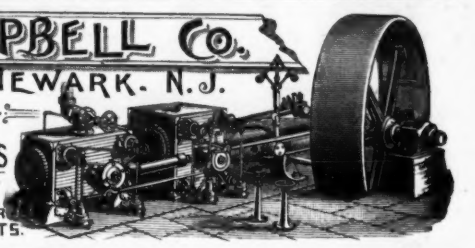

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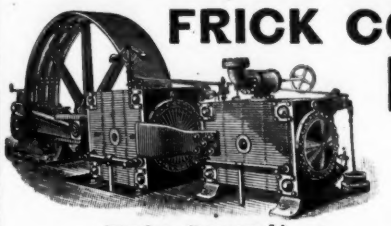

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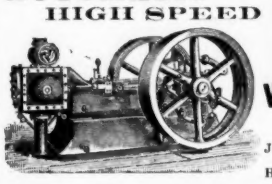

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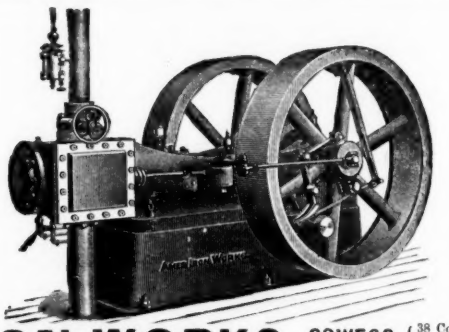

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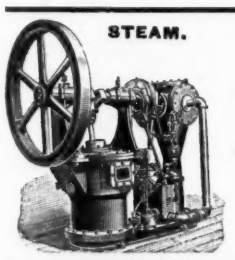

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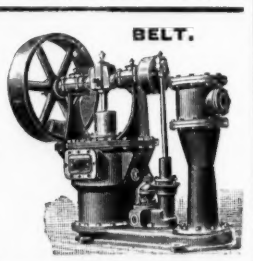

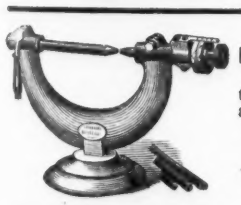

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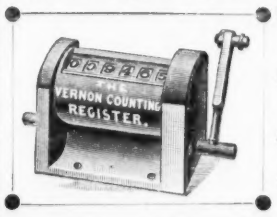

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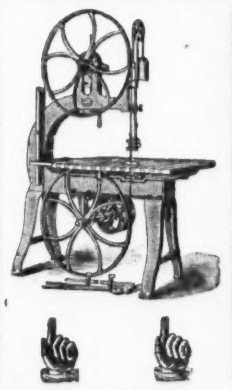

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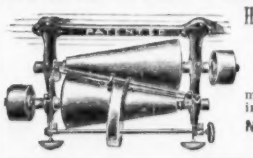

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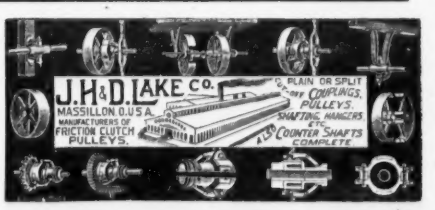

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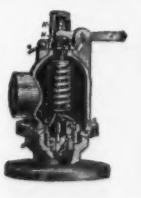

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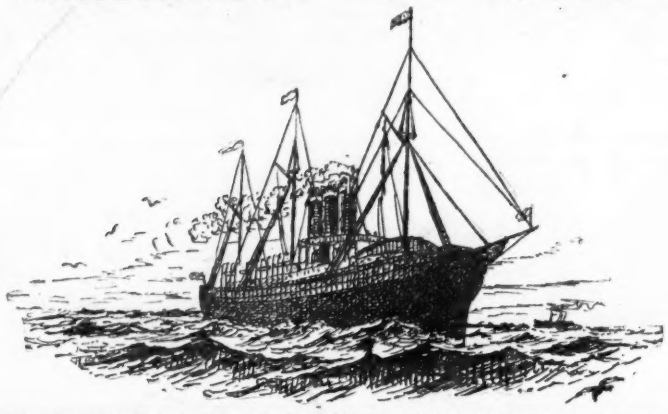

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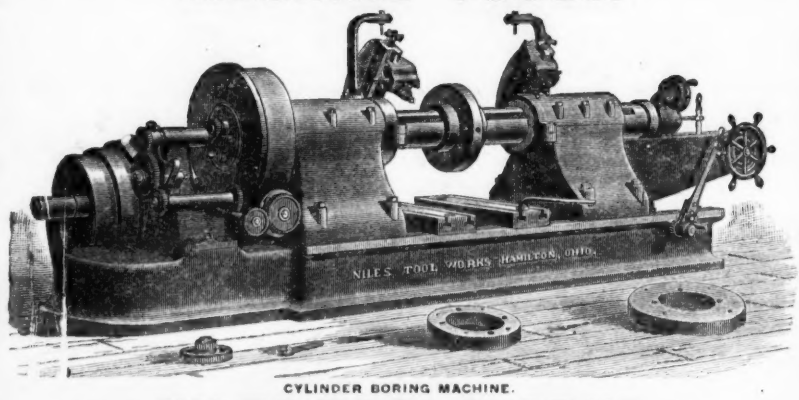

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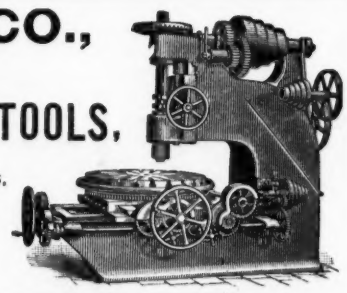

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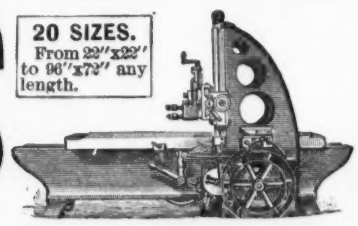

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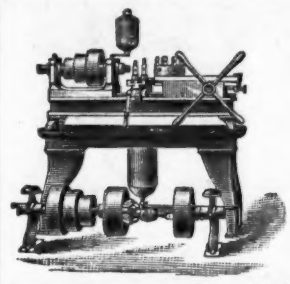

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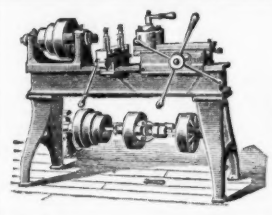

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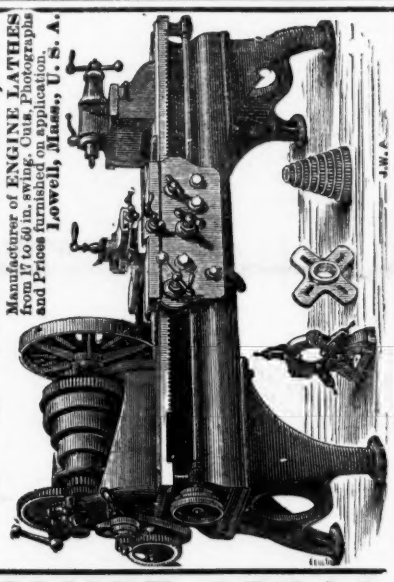

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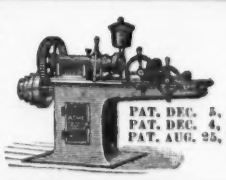

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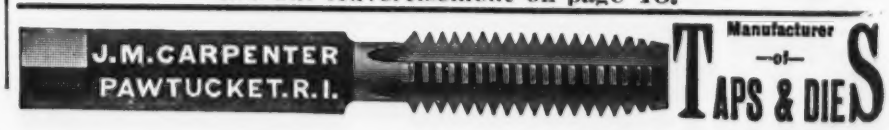

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